25¢

VILHJALMUR STEFANSSON

Headline Series

FOREIGN POLICY ASSOCIATION

NUMBER FIFTY-ONE

HEADLINE SERIES

March-April 1945
No. 51

Headline Series

★

AFTER VICTORY . . .

A PEACE THAT PAYS

SKYWAYS OF TOMORROW

CANADA
Our Dominion Neighbor

ON THE THRESHOLD OF WORLD ORDER

THE AMAZON
A New Frontier?

LOOK AT AFRICA

MAINSPRINGS OF WORLD POLITICS

THE CHANGING FAR EAST

AMERICA'S FOREIGN POLICIES
Past and Present

EAST AND WEST OF SUEZ
The Story of the Modern Near East

RUSSIA AT WAR
Twenty Key Questions and Answers

THE STRUGGLE FOR WORLD ORDER

LOOK AT LATIN AMERICA
(Revised)

THE GOOD NEIGHBORS
The Story of the Two Americas
(Revised)

OVERSEAS AMERICA
Our Territorial Outposts

CONTENTS

JA
37
H43
no. 51

THE ARCTIC IN FACT AND FABLE 5

Imaginary Problems

1. THE FROZEN NORTH 8

2. FOLKWAYS ARE SHACKLES 32

The Real Problems

3. NORTH TO EVERYWHERE 53

4. NORTHERN DOMESTICATED ANIMALS 72

5. OTHER ARCTIC RESOURCES 83

6. GOOD NEIGHBORS 88

FORT YUKON: A CASE HISTORY IN EXTREMES OF HEAT AND COLD 91

(All illustrations are by Graphic Associates)

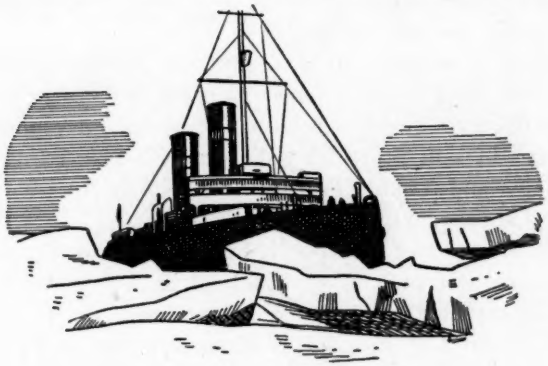
HEADLINE SERIES

No. 51

HEADLINE SERIES, NO. 51, MARCH 20, 1945. PUBLISHED BIMONTHLY BY THE FOREIGN POLICY ASSOCIATION, INCORPORATED, 22 EAST 38TH STREET, NEW YORK 16, N. Y. FRANK ROSS MCCOY, PRESIDENT; C. GROVE HAINES, EDITOR; EDITH R. GREENBURG, ASSISTANT EDITOR. SUBSCRIPTION RATES $2.00 FOR 10 ISSUES. SINGLE COPIES, 25C. ENTERED AS SECOND CLASS MATTER AUGUST 19, 1943, AT THE POST OFFICE AT NEW YORK, N. Y., UNDER THE ACT OF MARCH 3, 1879.
COPYRIGHT, 1945, BY FOREIGN POLICY ASSOCIATION, INCORPORATED.
PRODUCED UNDER UNION CONDITIONS AND COMPOSED, PRINTED, AND BOUND BY UNION LABOR. MANUFACTURED IN THE UNITED STATES OF AMERICA.

Some service man will be interested in this. After you have read it, why not send it to your nearest camp or hospital library?

The Arctic in Fact and Fable



VILHJALMUR STEFANSSON

THERE ARE TWO KINDS OF ARCTIC PROBLEMS, THE IMAGINARY AND the real. Of the two, the imaginary are the more real; for man finds it easier to change the face of nature than to change his own mind.

Since they are the more difficult, we consider the imaginary problems first. Also, you cannot approach physical difficulties with the right mental attitude unless you first get past the mental hazards.

LOCATING THE ARCTIC

Our immediate purpose is to deal with "The Arctic" as that region surrounding the North Pole which is as yet little colonized. Generally speaking, this means a region that has been "discovered" within historic time and which still remains comparatively undeveloped, in the sense that there are few such institutions as cities, roads, schools. The population of European

ancestry is small, and what there is of it is engaged mainly in frontier enterprises such as trading with natives, whaling, pioneer mining, law enforcement, missions. We cover the region usually called "Arctic and sub-Arctic."

In Canada something over 11,000,000 people dwell in the southern one third of the country, a good deal fewer than 100,000 in the northern two thirds which, roughly, corresponds to the political subdivision Northwest Territories. This is our field in Canada—this and Yukon Territory. In North America we deal also with Labrador and Alaska.

Greenland is part of our sphere, but not Iceland, for conditions in Iceland are not such as we think of as Arctic, or even sub-Arctic; for instance, the average temperature of Reykjavik for the coldest month of the year is about like that of Philadelphia. For similar reasons, we do not deal with the western seacoast of Scandinavia, though we do include the northern interior, roughly Norwegian, Swedish and Finnish Lapland. Eastward from there in the Soviet Union we include a belt which is at first narrow but widens eastward to embrace large parts of the basins of the great north-flowing rivers, the Ob, Yenisei and Lena, streams comparable to the Mississippi, and the basins of the smaller streams which have a comparison range between the Hudson and the Missouri in the United States.

These are the mainlands with which we deal, and the islands to the north of them. On the north they are separated from each other by a mediterranean sea that is navigable around its edges during the summer months but otherwise covered by drift ice that prevents navigation by ordinary vessels. During winter the margins of the sea ice are landfast against various coasts. Apart from this, even in mid-winter, the floes are moving. There are no vast expanses of ice but millions and billions of cakes, ranging in area from the infinitesimal to several hundred square miles.

When floes break during summer they remain separate until autumn, dividing and redividing, becoming smaller and smaller.

As winter approaches and frosts increase, the floes begin to be cemented together, and you have two processes going on side by side and compensating each other. Under stress of wind and current, perhaps through the impact of near-by floes, there are cracks forming, technically known as leads, in which open water appears where there had been ice. Thus the number of floes is increased, even during the coldest month of winter. But ice forms rapidly on the open water when temperatures are low, bridging the leads and cementing the floes, joining them up into new combinations and so decreasing the number of individual pieces.

The motion of sea ice is at all times sluggish. You can travel over it with comparative safety during winter, afoot or by sledge, for the floes are large, sometimes twenty or even thirty miles across. When you come to a break, you may be able to step across it; in any case, you can wait until the frost bridges over the lead, usually within two or three days.

In summer this kind of travel is difficult, for the floes are numerous and smaller, there is more open water, more motion, and, worst of all, there are ponds of water on top of the ice. These ponds are fresh water, incidentally, for sea ice, although bitterly salty when new, is gradually deprived of its salt content during the first year. Chunks from a floe which is nine months old can be broken off and melted into passable, slightly brackish drinking water. When the floe is more than a year old, you will have difficulty in noticing even a trace of salt, and when it is more than two years old you would need some delicate chemical test to determine that there is more salt than in rain water.

We shall talk, then, about the northern frontier lands of the New World and of the Old, with some reference to this mediterranean sea that divides them on the north, and to the rivers and lakes.

IMAGINARY PROBLEMS

1. The Frozen North

Central in the northern regions is the mediterranean sea—that gulf from the Atlantic which used to be called the Arctic Ocean, because it looked so big when expanded by a Mercator chart. On a globe it is not nearly large enough to be an ocean and is now usually called the Arctic Sea, or, occasionally, the Polar Mediterranean. Misconceptions of its nature as well as of its size are among the chief imaginary handicaps to realistic thinking about the North.

THE CASE OF JAN MAYEN

We take as an example a recent news story* about the island of Jan Mayen, which lies in the sea to the northeast of Iceland and west of northern Norway, and which is an important link in a chain of meteorological stations. In describing the experience of twelve Norwegians who landed on Jan Mayen in 1941, determined to keep the island in Allied hands, the writer of this press release assumes that, from late autumn to early spring, heavy ice makes the Jan Mayen coast unapproachable.

The island had been a meteorological station before the war but was temporarily abandoned in 1940. In relating attempts to

* *News of Norway*, October 20, 1944. Issued by Royal Norwegian Information Service, Washington, D. C.

reoccupy it, in order to prevent its seizure by Germany, the story says that "Neither the Allies nor the Germans would be able to reach the island before early spring . . ." In March 1941 the Norwegians did reach Jan Mayen, to establish a permanent base. They found the weather so cold and stormy that ". . . for about half the year it was almost impossible to leave the huts . . ."

The parts of the Jan Mayen release concerned with ordinary sea ice and cold weather conditions seemingly grow out of a deeply imbedded general misconception about northern seas and weather. There has been evidence through the centuries, specifically documented in recent years, that the first sea ice seldom appears near Jan Mayen before Christmas, and then only if there have been persistent northwesterly winds. With the New Year the chance that ice will come grows month by month, and is greatest around April and May. There is sometimes considerable ice in June and even in July; very seldom is there sufficient ice in November or December, south from Jan Mayen toward Iceland, or east toward Norway, to offer a problem for navigation.

An early attack upon the belief that there is a lot of ice in winter between Jan Mayen and Iceland was made by Christopher Columbus. The biography written by his son Ferdinand, tells that in February 1476, the future Admiral of the Ocean Sea cruised a hundred leagues north from Iceland, thus about 300 miles, without seeing a piece of ice in the ocean, which was one of the reasons for his conclusion that those are equally wrong who believe that the tropics are too hot and the polar regions too cold for the ordinary uses of man. This voyage of Columbus, if made, was to the vicinity of Jan Mayen.

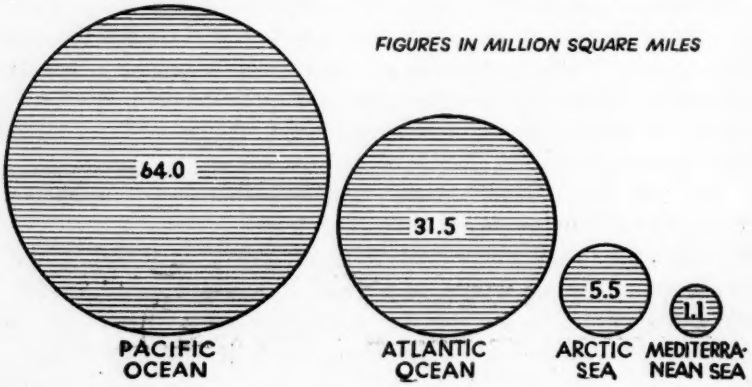
But the learned men of the centuries following the alleged voyage of Columbus "knew" that it was not possible for him, or anyone else, to sail that far north from Iceland in February, because ice in the sea would stop them. It was doubly impossible, they considered, to sail that far without coming within sight of ice. So they concluded that the story was a lie, and used it there-

after as one of the cornerstones of the doctrine that, generally speaking, Columbus told the truth only when it suited him. The authorities, no matter how reluctant, were forced to acknowledge that the Columbus story was against the laws of nature—as they understood them.

Well into the nineteenth century all Europeans to whom the scientific world gave much attention were convinced that the sea between Iceland and Jan Mayen was jammed with ice throughout the winter. Notable among these was the distinguished Icelandic geologist and geographer, Thorvaldur Thoroddssen, who said no one could sail a hundred Spanish leagues north from Iceland in February because of ice hindrance.

Then came the "International Polar Year" of 1882-83, in which there were concerted scientific studies by many nations. As their contribution, the Austrians sent an expedition which wintered in Jan Mayen. Their observations confirmed the "ridiculous" story of Columbus.

In 1921 a citizen of the United States of Norwegian descent, Hagbard Ekerold, led a small expedition to Jan Mayen to establish there a permanent weather observatory. The Ekerold station, after being privately operated for a year, was taken over by the Norwegian Government, which maintained it thereafter



up to and into the Second World War, claiming the island as Norwegian territory. The Norwegian government observations, as well as those of Ekerold, supported Columbus and the Austrians. During early winter these men hardly ever saw any ice in the sea as they looked from Jan Mayen in the direction of Iceland.

A severity of climate which made it practically impossible for the hardy Norsemen of 1941, after they finally got to Jan Mayen, to go outdoors, seemed particularly strange to me; for my friend Ekerold told me that it was never particularly cold on Jan Mayen the winter of 1921-22 and that he usually did not dress for the 2 A.M. weather observations, taking them commonly in his underwear.

Things seem to be going as smoothly now on Jan Mayen as even Ekerold would have expected. According to the news release, Jan Mayen was at the time of writing "described as being 'a completely self-contained community' today. The headquarters camp is virtually a little village with men and officers living together in a completely democratic way, sharing all hardships and perils together. There has been surprisingly little sickness, and colds occurred only after men had been aboard supply ship."

THE ORIGIN OF THE FROZEN NORTH

It is a commonplace that the beliefs of man are largely inherited. Those about ice in winter around Jan Mayen are traceable to the Greeks of more than two thousands years ago.

We can trace at least as far back as 500 B.C., to the Pythagorean school of Greek philosophy, the doctrine that the earth is spherical. From this theory, from limited observation, and from unlimited confidence in the truth of those deductions which seemed reasonable to the best minds of Greece, there evolved the Doctrine of the Five Zones. The philosophers believed, as we still do, that temperatures on our earth are controlled by the sun. How hot the day or season depended on how high the sun was at noon.

According to the usual view of the ancient cosmographers, which grew into a dogma, it was so hot on the earth right beneath the sun that no life could exist. This was the Torrid or Burning Zone.

North of the Burning Zone it would sometimes be too warm and sometimes too cold, but life was possible for animals and plants. In countries like Greece the weather was pleasant on the whole. This was the Temperate or Livable Zone.

According to the belief, which was supposed to rest equally upon observation and theory, it grew warmer as you went south from Greece until you came to where the heat was difficult to endure. If you persisted in going farther south you would die from the heat. Similarly, if you went north from Greece it got chillier and chillier, and if you went far enough you would die from the cold.

The Greeks may have known from correct report that it becomes very hot in North Africa. By our own weather observations, the temperature does rise to 136° F. in the shade at Azizia in Tunisia, about 700 miles north of the northern edge of the tropics. To the Greeks, who realized that the equator was a long way south of this place, it seemed a reasonable deduction that if a traveler were to continue southward it would presently become so hot that neither plant nor animal could live. They did not know from observation, as we do now, that when you proceed south into Africa the extreme of heat becomes less and less until it is comparatively tolerable on the equator. In fact, there are few places on the equator in Africa or South America that go much above 100° in the shade.

The similar observations of the Greeks, or their hearsay, extended northward chiefly in the direction of the Black Sea and the region beyond, which they called Scythia. Probably some of the barbarian traders, who penetrated to the Black Sea from the north, had experienced what we call 50° below zero, and at no great distance—well south of where now stands Moscow.

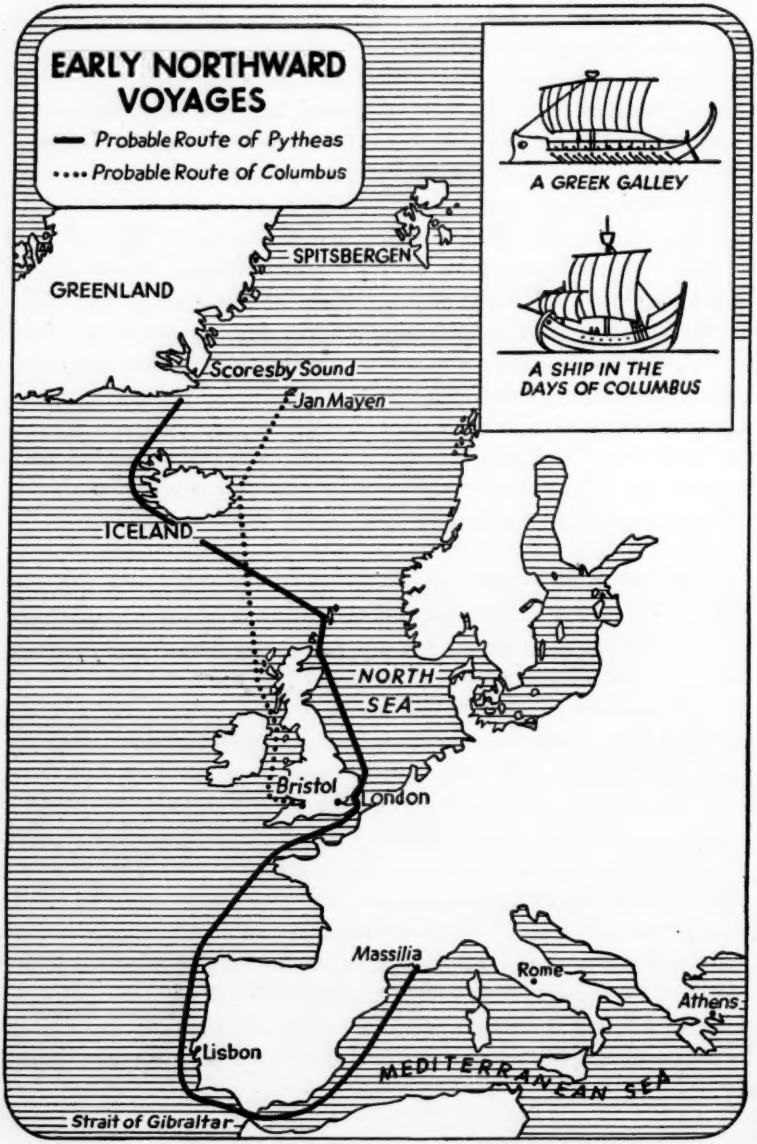
The Greeks had an approximately correct idea of the size of the earth. Some say that by 150 B.C. they had computed its circumference within less than 5 per cent of error. They certainly had an excuse then, if not a sound reason, for believing that if you continued north far beyond Scythia you would come to a region where life would be impossible because of the cold; for certainly the North Pole lay far beyond Scythia.

From the concept of a spherical earth heated by the sun, the Greeks deduced that south of the flaming tropics there would be another habitable zone and beyond this south temperate zone would be a southern frigid region. But, said the Greeks, these deductions would always have to remain within the realm of theory. Sometime somebody would go around the earth from west to east or east to west; but nobody would ever go around the earth from south to north or north to south—first because no one could cross the burning tropics, which is reason enough; secondly because no one could cross the frozen zones.

THAT LIAR PYTHEAS

We of today are unable to believe what we think contrary to the laws of nature; but there are few who have such faith in what we call natural law as the Greeks and their disciples had in the conclusions of their philosophy. Perhaps the most striking example of this was the two-thousand-year disbelief in the reports from the voyage of Pytheas.

It seems clear that Pytheas was the first definitely to connect the moon with the tides. He was also the first to locate a place on the surface of the earth by observations of heavenly bodies, thus the first to determine latitude on concepts similar to those which we use today. With these and many other freely and widely acknowledged achievements to his credit he sailed from Massilia, now Marseilles, west through the Strait of Gibraltar and north along the west coast of Europe. He seems to have been away from the Mediterranean two or three years. On his return


EARLY NORTHWARD VOYAGES
Probable Route of Pytheas
Probable Route of Columbus
A GREEK GALLEY
A SHIP IN THE DAYS OF COLUMBUS
GREENLAND
SPITSBERGEN
Scoresby Sound
Jan Mayen
ICELAND
NORTH SEA
Bristol
London
Massilia
Rome
Athens
Lisbon
MEDITERRANEAN SEA
Strait of Gibraltar
GRAPHIC ASSOCIATES

he wrote a book, now lost, called *The Ocean*, in which he described his voyage.

Everyone seems to have believed what Pytheas told about Spain and France, England and Scotland, for all of this fitted in with the doctrines then held by the learned. No one believed him, or at least none of the cosmographers, when he said that he had made a six-day voyage (about 600 miles) northward from Scotland and found there an island called Thule.

It was just not possible to believe the Thule stories; for no philosopher then doubted that the Frozen Zone, where it is always cold, where no one could sail because all water was frozen, began just to the north of Scotland. Pytheas insisted that, on the north coast of Thule, he had observed the sun skimming the northern horizon along an unfrozen sea in midsummer. It was bad enough for him to claim a liquid ocean that far north; he made it worse by asserting he had gone a day's sail north from Thule before finally meeting ice in the sea.

What was doubly unbelievable then sounds to us like a simple statement of everyday fact. Thule was Iceland. If you assume that the Greeks steered north from the northwest corner of Iceland they would strike ice near Scoresby Sound, East Greenland, and that would be a day's sail, about 100 miles.

Pytheas told what fits in with our modern knowledge. He became the most notorious liar of antiquity through telling things which would not fit in at all with what people then "knew" to be so.

The greatness of Pytheas should have been established to the learned world during the ninth century; for in 820 the Irish monk Dicuil, then resident in a continental university, wrote his book *De Mensura Orbis Terrae*, in which he mentions as a commonplace a voyage on which some Irishmen left for Iceland in February and returned to Ireland the following August. But it is only within the last thirty years that Pytheas has been widely accepted as one of the greatest discoverers of all time, to be ranked

with Erik the Red, Henry the Navigator, Columbus, Magellan, Peary.

UNVEILING THE REAL NORTH

That Iceland was habitable became well known throughout Europe only when the Norwegians had taken Iceland over from the Irish, and established there a republic which became a Christian nation by an action of their parliament in the year 1000. Then began that widespread knowledge of the Arctic and sub-Arctic which necessarily accompanied the collection of tithes by the Roman Church. For they collected them not merely from the north coast of Iceland but from the west coast of Greenland, where the Icelanders planted colonies that were converted to Christianity about the same time as the mother country.

That settlement was possible north of Europe far beyond Iceland came to be widely known when the Dutch under William Barents and the English under Henry Hudson visited the Spitsbergen group, the Dutch during the last decade of the sixteenth century and the English in the first decade of the seventeenth. One of the striking entries in the logbook of Hudson is: "I think this land may be profitable to those that will adventure it."

Europeans, chiefly the Dutch, the British, and the Russians, did adventure Spitsbergen, the south coast of which is about 600 miles north of the Arctic Circle. They found it profitable. Through the more than two hundred years between Hudson and the rise of kerosene, when "fish oil" was the light of the world, Spitsbergen was the source of more illumination than any other part of our globe.

THE TENACITY OF INHERITED BELIEF

There is not space here for a history of the northward progress of knowledge. We merely give a few disconnected examples of how change in general thinking failed to keep step with the progress of geographic discovery.

In the common experience of early modern times, scurvy was the deadliest of diseases on long sea voyages. The loss of half the crew was usual; the loss of three fourths, as on the famous voyage of Lord Anson, was not extraordinary. Through stories which everyone knew, practically all the men lost by Anson, and most of those who died of scurvy on the Magellan ships, as indeed on many other famous voyages, had died within the tropics; yet the belief grew, apparently from a general faith in the virtues of sunlight, that sunshine and warmth would prevent scurvy and that a winter in the Arctic, if not fatal from direct freezing, would almost certainly be fatal to all or nearly all hands from a scurvy caused by lack of warmth and of midwinter daylight.

Then came an accident in the summer of 1630; eight Englishmen were left behind in Spitsbergen by their whaling ship. There was no house for them, and no food except decayed cracklings where they had been trying out whale oil. The marooned sailors built a hovel for themselves, lived on the blubber cracklings, on pieces of decayed whale meat, and on a few animals they were able to secure with weapons and ammunition they had with them—for they were on a reindeer hunt when their ship was driven away (or when she deserted them maliciously, as they believed).

The following spring, after nine months and twelve days, these men were in good health when the whaling vessels returned to Spitsbergen.

The Dutch, active and intelligent competitors of the English, drew what would seem a reasonable conclusion—that if Englishmen could live a winter in good health with improvised clothing and shelter, and with no "good" food, it would be easy for Hollanders to winter if well-housed, well-clad, provided with the standard foods and medicines.

It was thought that if men could remain near the "fishing" grounds through winter and early spring they would get information about seal, walrus, and whale that could be of great value. Accordingly, seven Hollanders were put ashore on Jan Mayen

and seven others on Spitsbergen. They were comfortably housed and were provisioned according to the ideas of the day. For instance, they had ovens so they could bake fresh bread as if they were at home in the Netherlands. They had the makings of porridge; they had salt meat, beer, wine, and sauerkraut; and they had the remedies against scurvy which commanded the faith of that period.

Both groups of men kept diaries, from which we know their end. Those in Spitsbergen secured no game, lived exclusively on the "good" food that had been provided them, sickened after two months, and were all dead inside of four, from scurvy. The Jan Mayen party secured two polar bears. Although they lived approximately twice as long as the others, they were all dead of scurvy before the ships returned to pick them up.

The over-wintering safety of the Englishmen who lived exclusively on meat did not make any impression, so far as we can see, upon the medical or other relevant thought of Europe. The death of the two groups of Hollanders, well-housed, well-clad, well-fed and provided with medicines, demonstrated to Europe that the earlier belief was correct—that Europeans could not safely winter in the Arctic, and that scurvy descended upon whoever spent long periods beyond the direct reach of the sun. Even today when travelers come back from the North, saying that they have lived exclusively on meat for long periods, they are asked, as they would have been in the seventeenth century, "How in the world did you manage to protect yourselves from scurvy?"

THE MIGRATION OF NORTHERN ANIMALS

The ancient belief that animals, particularly grazing animals, would move north in the spring when the snow thawed away, and would retreat south in the autumn, was confirmed again and again by supposed observation. Typical is the case of the Parry expedition, which wintered at Melville Island to the north of

Canada, about 575 miles north of the Arctic Circle, the season of 1819-20.

In the report of the expedition, the members of which seemingly never went more than a few hundred yards from the Winter Harbor headquarters until spring, you are told that both caribou and musk oxen left Melville Island in the autumn, migrated south to the forest, which here is 600 or 700 miles away, spent the winter in the forest, and returned north in the spring—to be observed by the Englishmen when they came out of their hibernation. It does not appear to have occurred to anybody on the Parry expedition that the beasts they saw grazing when they last ventured abroad in the autumn, and again when they first sallied forth in the spring, might have been grazing there all winter.

Between 1820 and 1855 there were numerous Arctic expeditions, about which many books were written. Most if not all these books stated or implied the usual views on migration. The first known printed appearance of a detailed argument against the belief that the animals of the Canadian Arctic flee southward in autumn, to avoid the winter cold, is by Sherard Osborn,* of the British Navy; in the second (1857) edition of *The Discovery of the North-West Passage*, he devotes a chapter to this argument, "The Migration of Animals Theory."

But Osborn was denounced as a heretic when he first advanced to his wintering colleagues on a polar expedition the view that many of the animals in the Canadian Arctic islands do not necessarily leave during winter the island on which they spend the summer; and that, if they do leave the home island, they are as likely to move north during winter as south.

* Several writers before him had asserted for different parts of the Arctic that reindeer do not necessarily migrate—among them Frederick Martin in a narrative published in 1694. Even earlier, in the *Kings' Mirror*, written in Norway probably during the thirteenth century, we have, along with the rest of what a well-instructed king should know, the information that both wild and domestic grazing animals live in Greenland the year through.

Further observation has confirmed the report of McClure for 1852-3 in Banks Island, that caribou are numerous in its north end during winter. Indeed it has been established that caribou are most numerous south of the middle of that island during summer and north of the middle during winter; that in mid-winter they crowd up toward the north end.

There are large sections of North America where caribou move south in winter and north in the spring. But even on the mainland it is not an unbroken rule that winter movement is southward. For instance, in the Cape Parry region of central northern North America, we found by our own observation and learned from the Eskimos that caribou frequently, though not always, move south into the forest during late August, September, and October, beginning to move north again in November, and that during many seasons they crowd to the north coast and northward on the Cape Parry Peninsula in late autumn and just before Christmas. As the coldest Arctic period is January-February, these animals are moving north during a time of increasing cold.

SOME NORTHERN ANIMALS DISLIKE THE SUMMER

There is, indeed, no evidence that caribou suffer from cold. The evidence is that musk oxen actually prefer cold, for it seems a reasonable assumption that animals like a condition under which they grow fat, and, generally speaking, musk oxen are fattest at the end of winter. Bull caribou begin to gather fat in December, picking up more and more during the still colder months of January and February, and continuing to get fatter through the summer, reaching their maximum in August. A cow is skinniest in May, just after she drops her calf. She begins to pick up fat around July or August, and gains fat from that time until near or past Christmas.

It may be said, then, that the musk ox fat cycle confirms, and that the caribou cycle does not contradict, the hypothesis that the typically Arctic grazing animals prefer winter to summer.

ANIMALS AND PLANTS STUNTED BY THE COLD

Another of the Greek doctrines which still control much of our thinking is that things tend to be large in warmth and small in cold. Metals expand with heat; there are gigantic trees and gigantic animals in tropical countries. Then there are many animals and plants that live in the tropics and cannot live in the temperate zone; other species live in the temperate zone and cannot live in the Arctic. But there are also various organisms that have a southward limit, corresponding to that northward limit.

The biggest sea animals now upon our globe are whales; the largest modern whales are the largest animals that ever existed. The very greatest of all beasts that ever lived are the blue whales, and these the whalemen seek by penetrating the outer fringes of the Antarctic ice and getting into the comparatively open water between this drift ice and the southern continent, where the sea brine is three or four degrees colder than the freezing point of fresh water, and where they take monsters that run up to 115 feet in length. Some years ago, 10,000 of these whales were captured there in one season. The second greatest of the whales is the bowhead, found in the chilly waters of the north and formerly sought by our Yankee whalemen beyond Alaska and off Greenland.

The biggest of our carnivorous land animals which still survive are members of the bear family. The greatest of all the bears is the Alaska brown bear, sometimes referred to as the Kadiak. The second largest is the polar bear. Either of these bears is much larger than any found nearer to the equator in the New or Old World.

There are plants also that grow larger the farther north they go. On my first northern journey I met at Dawson, in the Yukon, about 100 miles south of the Arctic Circle, a woman who came there from Indiana. She had brought with her tuberose seeds from plants that were only about knee-high in Indiana; they grew shoulder-high at Dawson. It is a commonplace that larger cabbages are grown in Alaska than in Washington, Oregon, or California.

We are not, of course, trying to prove as a principle that things get bigger the farther north they go. We are merely pointing out that there is no simple law of nature according to which plants and animals get smaller the farther they are from the equator, or in step with the growing length and the deepening chill of the winters.

THE NORTHERN BOUNDARY OF LIFE

One of the necessary deductions from the doctrine of Five Zones was a northern limit of animal and plant life. Explorers, mediaeval and modern, when they find animals and plants ahead of them wherever they go, frequently explain that probably these plants or animals were observed near their northern limit; beyond was, no doubt, a region without life.

The existence of a boundary in the North beyond which life would not go was such a profound conviction as late as our 1913 expedition that we met nearly universal disbelief, and frequent ridicule, when we announced a plan to travel over the drifting sea ice by sledge and dog team northward from Alaska, depending for the food of men and dogs, and for fuel as well, upon the lean and the fat of animals.

We urged, in support of our plan, that we had examined all the arguments against there being life in the northern sea and had found them of a kind that would appeal to a philosopher but would not necessarily appeal to a fish; we said we did not believe that fish would know enough to refrain from trespassing beyond their philosophically-determined limits. Even if the fish were so discreet, there are in the ocean plants and many animals that do not swim and must, therefore, drift with the current; and there were pretty well known to be various currents in the polar sea, as there are in all seas. We argued that the floating life would go with the current and that the predatory animals that swim, the fishes and seals, would follow the feed.

When three of us eventually traveled north by sledge over the sea ice the winter of 1914, we were all white men; for all the Eskimos of northern Alaska agreed with most whites that we could not live by hunting on such a journey because there would be no animals to hunt. The Eskimos believed, not that animals will refuse to go far north, but that seals will refuse to go far from land.

As Storker Storkerson, Ole Andreasen and I traveled north from Alaska we found in some places more game and in others less, as you do when you cross a continent; but there seemed no correlation of this with latitude. We carried food for less than forty days and we traveled more than ninety. The latter part of the journey we lived exclusively by hunting, for we had exhausted the groceries we took with us. We did not miss a meal, we lost no dogs, and our dogs were fatter when we landed on northeastern Banks Island, after 700 miles of sledging over drifting sea ice, than they had been thirteen weeks before when we left Alaska.

But so firm was the belief in the lifelessness of the polar sea that many preferred to think we were liars rather than that we had made another dent in the armor of mediaeval cosmographic thought. However, the typical reaction to our report was not outright disbelief but rather the argument that, no doubt, if we had gone farther we would have entered the lifeless region.

Thus it still appeared in 1921 that Columbus was ahead of the twentieth century when he was willing to conclude, from what he had seen and heard during the latter part of the fifteenth, that life is no more impossible in the farthest north because of the cold than it is at the equator because of the heat. But to settle the question whether Columbus was right or wrong, someone would have to go to the very North Pole and make the required studies at a place which, by definition, was farther north than any other.

Peary had reached the Pole in April 1909. He had not been concerned with life in the sea, but rather with the problem of getting his men and dogs back alive after making the necessary observations to determine that he had reached the Pole. For, unlike some later explorers, he was not trying to live by hunting but was depending on pemmican which he had brought with him.

By 1930 leadership in polar exploration had passed from west Europeans and North Americans to the Union of Soviet Socialist Republics. No one was any longer concerned about merely getting to the Pole; for after Peary it had been visited once by airplane and twice by dirigible. The program of the Arctic pacemakers was now economic, scientific, political. So when a Soviet expedition went to the North Pole it was primarily for technical study and, as some of the reports had it, secondarily to establish Soviet hegemony in the polar sea. Four 4-engined airplanes, under the command of Professor Otto Y. Schmidt, at that time Chief of the Administration of the Northern Sea Route, took off on May 21, 1937, from their most northerly Arctic Station—on Rudolf Island—and flew about 500 miles to the North Pole, and just beyond it as viewed from the Old World side. The airplanes and most of the personnel returned to Moscow, after depositing equipment and supplies, leaving a party of four scientists. The commander was Ivan Papanin; the other members of the party were Ernest Krenkel, Peter Shirshov, and Eugene Feodorov.

As soon as the Papanin group had leisure, they took walks

some distance to where the ice had been cracked by differential stress. There they saw seals swimming around in the water, gulping down shrimps that were floating near the surface. The camp was visited by many birds of several species, and the explorers came to recognize this as the ordinary pattern of life at the Pole.

Later, using the ordinary technical procedure of marine biology, they lowered traps farther and farther down into the water, opening them and then closing them at greater and greater depths and bringing to the surface the captured plant and animal life. Thus they established, all the way from the surface to the sea bottom about two and a quarter miles below them, a life gradient similar to that of the North Atlantic, from which indeed the polar sea is a gulf.

The visit of a mother polar bear, with her two cubs so small that they obviously must have been born on the ice right near the Pole, completed the overthrow of the doctrine that there is a northern line or limit beyond which plants and animals do not go.

THE CHILL AND GLOOM OF THE POLAR WORLD

In its handicapping power second only to the belief that life is not possible in the remote North is the supplementary view that ordinary human beings would not like it. This general view comes under a number of specific headings, among them that it is too cold in winter, that it is not warm enough in summer, that the absence of sunlight in winter has a depressing effect on the human spirit, and that, in any case, activity in the North is possible in summer only, the winters being a time of confinement, a sort of hibernation.

As to the intensity of cold, it is fairly well agreed that if you were to spend a whole year at the very North Pole, latitude 90° North, or even a whole century, you would never observe a temperature colder than 55° below zero. Make it −60°, to be liberal; three states in the Union, according to *Climate and Man*,

the 1941 Yearbook of the Department of Agriculture, have records that cold or colder. They are Wyoming, −66°; Montana, −63°; and North Dakota, −60°. There are people living at the special cold spots in these states some of whom will tell you that they like the climate.

We know that on the whole Arctic coast of the North American mainland there is no weather bureau record as cold as 55° below zero. There are five states of the Union which have records of −55° or colder. These are, in addition to the ones already named, Minnesota, −59°, and South Dakota, −58°.

As you go south from the north coast of the mainland, whether in the Old World or the New, the extreme minimum temperatures of winter get lower and lower until you have passed out of the Arctic into the north temperate zone. So far as we know at present, the coldest spot in North America is at or near Fort Good Hope, on the Mackenzie River, about 20 miles south of the Arctic Circle, with a minimum record of 79° below zero. In the Old World, the coldest spot is Oimekon, in Yakutia province, about 150 miles south of the Circle, with temperatures colder than 90° below zero, meaning something lower than 120 degrees below freezing.

Continuing farther south, whether in North America or Siberia, the lowest temperatures are progressively higher and higher; but as we have said, you have to go to and through the state of Wyoming in North America, and correspondingly far south in the Old World, to reach a point where it is less cold on the chilliest day of the year than the lowest theoretically possible record at the North Pole.

We are talking of low, level country in this entire discussion, for we are concerned with places where men live or can live, not with mountain tops. However mountain tops are not at all times colder than valleys. Mountain heights are relatively cool during summer and on comparatively warm days in winter; but on any day that is colder than 40° below zero in the valley you are sure

to find it growing warmer gradually as you climb a near-by mountain slope.

Nor is it true, as formerly believed, that places which are very cold in winter are also very cold in summer. The cold pole of our earth, so far as we know, is at Oimekon; and this town is in a forested district, with some of the land in grain fields. Experimental stations of the Soviet Government may now be planting wheat; but according to our information, which is of some years back, the farmers around the cold pole were raising barley, oats, and rye.

When I first went north down the Mackenzie River, in 1906, I found at the cold pole of North America, Fort Good Hope, not merely a beautiful garden but the information that potatoes from it were shipped downstream for the trading posts of Red River and Mackenzie River and also upstream, southward. Today potatoes are grown both south and north of Good Hope and its preeminence as an exporting center of garden produce has disappeared; but the fact remains that, since the latter part of the nineteenth century, the cold pole of North America has been well known for its vegetable and flower gardens.

Great heat in the Arctic summer is found only on low, snow-free land; and, excepting Greenland, more than 90 per cent of all Arctic land is snow-free in August. Greenland is a mass of ice because it is a mass of mountains, but even in Greenland 15 per cent or more of the land is low enough to be ice-free. Peary Land, at the north tip of Greenland, is one of the largest ice-free parts of this island continent. Peary was there in summer and reported bumblebees and butterflies among the flowers just back of the most northerly coastline in the world.

It is never hot out on the polar sea, for the drifting ice and the cold water act as refrigerators; but it thaws even at the North Pole in midsummer and it rains instead of snowing. The Papanin expedition, in the immediate vicinity of the Pole, had their first rain of the season on June 28 and the last one on August 26.

We have disposed, then, of the first two points we just raised. The Arctic cannot be too cold for human habitation in winter, for if it were a number of our forty-eight states would be uninhabitable; it cannot be so very cold in summer or they would not be raising grain at Oimekon and potatoes at Good Hope.

WINTER IN THE ARCTIC

But is the absence of the sun depressing to the human spirit and are conditions generally such that you would go into a gloomy sort of hibernation for the winter? We consider the last of these points first.

Up to and including the expedition of Sir Edward Parry, who wintered in uninhabited Melville Island during 1819-20, it was the general belief that polar exploration would necessarily consist of active summers and hibernating winters. We have already mentioned how the first Parry expedition confirmed this by going into a kind of winter house arrest. But his second expedition, a few years later, was in a country where there were Eskimos. Parry and his men soon found that the Eskimos liked to travel in winter and that white men could travel also. From this time on, the idea that winter is a good period for northern travel developed, though slowly. Twenty-five years later John Rae, of the Hudson's Bay Company, was apparently the first to believe, argue and show by his own example that winter is a good season for long journeys. He failed to make any substantial number of converts even among the explorers. It remained for Rear-Admiral Robert E. Peary to demonstrate to the satisfaction of his fellow explorers of the Arctic (though not to those of the Antarctic) that winter is the best traveling season of the year.

Peary laid it down as a principle that in the Far North summer is for preparation, and in that sense for idleness. The favorable time for long journeys, when the ice is strong enough to travel on, starts, according to Peary's view, in January, the second coldest of the months, or in February, which is the very coldest.

Overland travel, or travel upon the frozen sea, would close in May or early June, when the snow begins to thaw in very high latitudes.

Those used to the Arctic climate have a general preference for mid-winter as against mid-summer. You will find that explorers whose expeditions were short, involving only one wintering, hardly ever affirm and sometimes strongly deny that winter is the pleasantest of the seasons. Explorers who have spent two or three winters begin to favor the cold season as pleasanter than the warm, this bias increasing with their length of service in the north.

The rule seems to be that you find in any part of the world a preference for the sort of climate to which the people there are most accustomed, this preference being the more clear-cut the more uniform the climate. Confining ourselves, then, to continental weather, which is more seasonal and less variable than that of northerly islands, we can lay it down as a safe bet that if in a given section the summer is longer than the winter, then the majority of the people living there are going to prefer the summer. But, if, as in Arctic Canada, Alaska or Siberia, the winter is notably longer than the summer, a majority will prefer the winter.

The proponents of summer will grow in number as you go south; those who prefer winter increase in percentage as you move north. The dividing line in North America is probably about the middle of Canada, somewhere near Great Slave Lake. In Alaska it is no doubt farther north, for Alaska is a peninsula and the ocean is permitted to give the southern part of the territory what is in effect an insular climate.

THE ABSENCE OF SUN

We come now to the last of our four points, the idea that the absence of the sun in winter has a depressing mental effect. We have, by implication, dealt with this common belief of Europeans; now we deal with it explicitly.

It is during the absence of the sun, as we have brought out, that overland and over-ice travel find their ideal conditions. Good travel conditions are particularly a requirement among hunting peoples, who must follow the game. This is easy in winter, when you can use dog sledges; it is difficult in summer, when the dogs carry packs and the people carry back loads, a cumbersome and laborious mode of travel.

The main transportation difference between the seasons is that you can walk on water only when it is frozen. In the summer boats can be used on large lakes or deep rivers and on the sea; being restricted to these channels is troublesome to the hunter, for the caribou do not obligingly travel along rivers, lake shores, or coasts, but tend to be on the open plains far from the large water courses.

In the whole North, and southward from the middle of Canada, the land on which grow the prairie grasses, as well as the trees of the forest, is permanently frozen when you get down a few inches or at most a few feet, and from there down in some cases to at least five hundred feet beneath the surface. Wherever the subsoil is frozen there cannot be any underground drainage. This means that on level or rolling land, anywhere except on mountain slopes, there is what may seem an incredible number of lakes; the surface of the country in vast areas is half water, in some large districts as much as 60 per cent water. The lakes, many of them shallow, are connected frequently by sluggish river channels.

Not only do you have to detour in summer when you come to a lake; you may detour in the wrong direction and find yourself an hour or two later at the tip of a peninsula. Moreover, even if the frost is only six or eight inches down, your feet keep slipping into mud-filled cracks between the hummocks of vegetation, and the clay is likely to stick to your feet, making them heavy and tiring you out.

Primitive Arctic man, therefore, does most of his traveling and

a large part of his work in winter, except in a few special districts. European man soon adopts the same practice.

For instance, when the Canadian National Railways were building the road from The Pas to Churchill in the 1920's, they learned during the first year that much of their work was more easily done in winter than in summer. On the assumption that the railway construction would be a summer job, with idle winters, they had estimated that the cost per mile over the frozen muskeg would be three or four times as much as the average in southern Canada. But the engineers discovered during the first building season the advisability of reversing many procedures. For instance, instead of stripping off the topsoil with its vegetation, they learned to leave it where it was and to put additional soil on top of that—or, rather, things like peat and moss. By removing the topsoil the first year they had converted what appeared to be solid ground into seas of mud, when the sun got a chance to strike a black surface; it takes years at terrific cost of money and labor to fill in these mud sinks with gravel. But, through discouraging the thaw instead of encouraging it, they were able the second year to build large sections of the road upon frozen ground so that it remained frozen and therefore continued to be as solid year after year as if it were a bed of concrete.

In short, these railway builders, by discarding standard engineering procedures, built easily, cheaply, rapidly and solidly a railway that would have been one of the costliest in the world if constructed by regular southern methods. It turned out to be, mile for mile, one of the cheapest railroads ever built in Canada.

It is only during the present war that most Americans are getting a few ideas on how to behave in cold weather. The procedure and principles seem obvious when you once get hold of them, as, for instance, that crossing rivers when they are frozen is easier for an advancing army than when the rivers are unfrozen.

But go back to the newspaper files that deal with the first Soviet-Finnish war and you will see that only a few years ago we did not

understand why the Red Army could advance the more easily the colder the weather. You will find our published comments on the first two months of that war filled with concepts that were in 1939 still almost exactly like those of our own Revolutionary War. Many things that look like advantages to us now, such as hard frost and the ice it produces, looked profoundly disadvantageous to us during the years that immediately preceded the Second World War.

It is in relatively southern countries like Italy, Greece, and Yugoslavia, even the Ukraine, where winters are only moderately cold, that summer campaigns are easier. As you go north, winter becomes more and more advantageous to those who know how to use it, particularly to an attacking force; when you are on the northern half of the Finnish-Soviet frontier, well north of Lake Ladoga, the winter becomes distinctly more favorable than summer, especially to heavily mechanized attacking forces.

2. Folkways Are Shackles

Our inherited southern folkways are in some cases nearly as much of a handicap in our dealings with the Far North as more general misconceptions. We consider a few points.

It was one of my first recommendations to the Office of the Quartermaster General, when I was called in during the first year of the war to advise on clothing, that instead of a few thick layers of winter clothes there be many thin ones. For the warmth of a garment depends not so much upon the solid materials of which it is made as upon air spaces that are in or between layers.

Consider a single heavy suit of woolen underwear weighing say two pounds, and compare it with two suits of woolen underwear weighing a pound each. You have imprisoned among the

wool fibers about the same number of air spaces in the one heavy as you have in the two light suits. But in the case of the light suits you have in addition certain air spaces between the two layers. This air weighs nothing, practically speaking, but it has considerable insulating value.

There are other advantages in having two layers. If the weather changes, you can take off or put on one suit; when cooling off you not merely remove the warmth of the suit that is taken off but you also get rid of one intervening insulation layer of air, thus permitting easier escape of heat from the body. Similarly, when you put on a second or a third layer in response to a drop in temperature, you add not merely the insulation of each garment proper but also the insulation of the intervening air.

But it is part of our folkways to wear heavy clothing in cold weather. We understand this to mean that each layer of clothes should be thick and therefore almost necessarily stiff as well as heavy. When I was sent by the Army on a survey trip to Labrador and Baffin Island, I learned from officers in charge of stores that they had been supplied both with thin woolen socks and thick ones, with instructions to explain to the men that two thin socks were better than one thick. But, I was told, the men simply would not believe this and insisted on getting what they called good woolen socks. Seemingly it is such attitudes of the personnel of Army and Navy, quite as much as that of the quartermaster departments, which are to blame for the discomforts our men suffer in cold weather, and for the large numbers of hands and feet that have been maimed or lost through freezing.

Less important, though serious, is the insistence of our soldiers that they must tuck their shirts inside of their trousers. This gives them for a few inches down from the waist double the insulating value that they get from either shirt or trousers. The trouble is that if you over-warm any part of the body, you thereby tend to warm up all the rest of the body, so that perspiration will ensue, not merely beneath the double thickness but also

on other parts. Once wet with perspiration, the clothes are less warm than when dry, and the wearer will be chilled if he does not actually freeze.

If you keep your shirt outside of your trousers, as do the Eskimos and a number of other cold weather peoples, you have an easy means of regulating body warmth. If you begin to perspire at an outdoor temperature of 50° below zero, or at any other low temperature, you will discover that nothing can be pleasanter than lifting your coat and shirt away from your body in front with one hand while with the other you keep the neck of the garment open, so that the warm air inside of your shirt rushes up and out, to be replaced by cold air from below.

Just as warming a part of the body tends to warm all the rest of it, chilling any part tends to chill the whole. Thus by cooling the front of your body you not merely stop the perspiration there; you also inhibit perspiration on your back, feet, or anywhere else.

This points up an advantage of wearing knee boots and knee socks in cold weather; if overheated, you can unloose your trousers and walk with knees bare like a Scotsman in kilts. You will find, if you do this, that chilling the knees not merely cools you off in general but that it also has a particular tendency to stop perspiration on that part of your body where it is most dangerous, your feet. If your feet perspire they are that much more likely to freeze later, because the moisture gets into the air chambers of the fabric, and the woolen sock or other footgear ceases being a good insulator and becomes a good conductor, permitting the loss of body heat.

The Scots and the Eskimos are right about their knee-length garments. The Eskimo way is better than that of the Scot, for exposing the knee is optional, occasional, and can be reversed.

OVERHANG OF SYMPATHETIC MAGIC

Some of the most disadvantageous of our beliefs and practices with regard to cold weather are inherited from a system of

thought and practice which had a strong hold in Europe during the Middle Ages—sympathetic magic. One of its doctrines is fundamental in a branch of medicine, homeopathy, a slogan of which is *similia similibus curantur*, like is cured by like.

If fever is cured by the thing which produces the fever, it means that heat is removed by the thing that causes heat; likewise cold is removed by the thing that causes cold—a frostbite by the application of something that is frozen. This is the basis for the precept: When you freeze your face, rub snow on it; melt the frozen flesh by applying frozen water.

If weather changes suddenly from comparative warmth to extreme cold, you may for a while have snow on the ground that is a little warmer than the air, for naturally it takes time for it to follow the air's lead. But it has not been 40° below zero very long before the snow, at least near its surface, is also 40° below. If your face now freezes when you are out of doors at this temperature, you have on your cheek, chin or nose a white spot or patch the temperature of which is a little below freezing. If you then scoop up some snow with a mittened hand and apply it to the frozen spot, you are bringing into contact two bodies, one of them say 5° below freezing and the other 70° below freezing. By one of the best known of thermodynamic laws, there is an interchange of temperatures; the warmer body becomes colder and the colder body becomes warmer. Your cheek, although frozen, will raise the temperature of the snow; the snow, on its part, will lower the temperature of your cheek.

This thermodynamic law is known to every high school boy and girl who has taken a course in physics. Still, at the beginning of this war, the Canadian Army used for a while a first aid manual which directed that frozen parts should be treated with applications of snow; the booklet said nothing about what the other conditions of the treatment were to be—such as first warming up the snow, for instance. And as late as 1944, at a United States Army training center, part of the instruction still was that if their faces froze, soldiers were to rub them with snow.

It is human nature to try to rationalize any belief that we have long held. It is, therefore, a common defense reaction to argue that, even if you must not use very cold snow, it may still be a good thing to use snow that is near the thawing point. But even this does not seem to be true.

HOW TO TREAT FROSTBITE

Before this war medical opinion was inclined to hold that a frost injury is likely to be the more serious the longer the protoplasm remains congealed. By that argument, time is of the essence. You should then do as the Eskimos do, thaw the frozen part by the application of body heat or by taking the victim into a warm room. Or you should, according to some medical journal articles, thaw with water heated almost, but of course not quite, to the scalding point; these articles assert, usually without theoretical explanation, that the quickest thawing gives the best results.

Now, according to the July 1943 issue of the quarterly *American Journal of Soviet Medicine*, it has been deduced from Red Army studies that there is nothing in favor of even slushy snow to thaw frostbite—except that by so doing we are conforming to usual practice, living up to the principle that the hair of the dog that bit you cures the wound.

However, studies made in the United States seem to show that it is a good thing to surround a limb, after it has been thawed out, with some such moderately low temperature as 50° above zero, in order to decrease, without decreasing too much, the flow of blood to the injured tissues. It may be then that cold applications to a frostbite, after it has been thawed, has a therapeutic as well as an anaesthetic value.

Accordingly, perhaps the best procedure with frostbite is first to thaw the frozen tissues with the application of body heat—as of a warm hand or an armpit, if you are out of doors, or at room temperature if a house or camp is available. Thereafter you might use ice water or slushy snow for reducing the pain. Cer-

tainly you will reduce the pain; that other effects of cold applications are also favorable has been claimed in the United States lately, as has been said, and perhaps on good grounds.

SNOW-EATING

Curious, and perhaps connected with sympathetic magic, is the idea that when thirsty you must not eat snow. This belief appears to be common if not universal throughout Europe. Seemingly all Asiatics, and the natives of the whole of North America, were strangers to the fear of snow-eating. On the contrary, it is the general practice of these non-European peoples, when they are traveling, to begin eating snow in the morning as soon as there is the least tendency to thirst, and to eat snow as required all day.

It is a common belief of snow-eaters, and probably correct, that you are more likely to hurt yourself on ice water than on snow. I can confirm this to the extent that I have never felt any ill effect from the hundreds and doubtless thousands of pounds of snow I have eaten during ten Arctic winters; but I have had some bad moments from ice water. On something like a half dozen occasions, during these same ten winters, I have been very thirsty when I reached water, usually because I had been running and had neglected to eat snow. On these occasions I have gulped large quantities and have felt slightly nauseated for perhaps half an hour.

Though I have never done it, or seen it done, I know it is possible to hurt yourself with snow. This is likeliest to happen if you believe firmly that you must not eat it and use will power to restrain yourself until it finally breaks down. You then start eating the snow in spite of yourself. If the day is comparatively warm, with the snow only a little below the freezing point, no harm will result; you will eat it somewhat as if you were eating sherbet, and with about the same effect. But if the temperature is anything like 40° or 50° below zero, and if you cram the snow into your mouth rapidly, you can freeze the inside of your

mouth, just as you could freeze a cheek by application of the same snow. If you swallow very rapidly you might even freeze your gullet.

If through accident you become very thirsty, compel yourself to eat the snow slowly enough so that it does not freeze your lips or other parts of the mouth. It might take you as much as half an hour to quench a raging thirst; the colder the snow is, the more slowly you have to eat it.

It is dangerous to quench thirst with unmelted ice, unless you take the greatest precautions. At low temperatures a chunk of ice will freeze to a bare hand and take off a piece of skin, about as cold iron would. Try to lick a piece of ice at −40° and your tongue will freeze fast, in which case you must tear it away at once for the frostbite will deepen rapidly. A piece of very cold ice cannot be taken into the mouth safely if it is larger than half a lump of domino sugar. So if you must use ice, scrape it down into a powder or pound it into small fragments, then eat it slowly as if it were snow. Grains the size of a pea will be safe enough, if you do not take many at a time.

SOUTHERN HOUSING IN NORTHERN CLIMATES

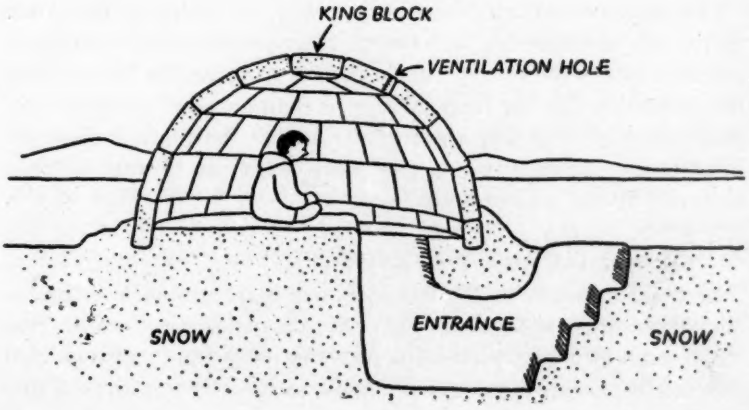
Preference for extreme cold to extreme heat is of course logical, for it is easier to protect yourself from cold than from heat. But to do so it is necessary to live in suitable houses, burn suitable fuel, and wear suitable clothes. And it is far from easy to get people of European culture to be sensible about their housing and their clothing. Take the house:

It is the custom throughout Europe and the Americas to enter dwellings by way of high doors built into the walls. If in a house you have a room temperature of 70° and outside an air temperature of −50°, there is a difference of 120 degrees, which means such a gravitational discrepancy that if you open the tall kind of side door a volume of warm air will rush out through the upper half while a similar volume of chilled air is crowding in

through the lower half, along the floor. Even if you open and shut the door quickly, you will have had a great loss of heat; but worse than that, the outdoors air will chill the indoors air near the floor to the dew point, and your room will fill, perhaps to the level of your knees or higher, with a thick fog that leaves everything damp.

Europeans meet this situation according to their general attitude toward the Arctic, one of combat. They fight the outer cold by building a "storm shed" or "storm porch." You open an outer door and the cold air goes into a space probably not much bigger than a telephone booth; you close that door before you open the one into the house, so that not a very large amount of cold air will enter the house. This is also essentially the method of the Arctic forest Indians, whose lowest temperatures go to 80° below zero, more than 110° below freezing. In so far as they keep the cold out from their dwellings they do it with one or more doors.

In North America, only the Eskimos dispense with the opening and closing of doors; at least they do unless they are civilized and prefer fashion to comfort.



In his summer housing the primitive Eskimo used doors in walls, much as we do, for then the air, outdoors and in, is of about the same temperature. In winter he acted on the principle that cold air is heavy and warm air light; at any rate he knew that if he entered his house from below he need not open or close the door, for gravity would prevent the chill from entering. He combined temperature control with ventilation by having in his roof an opening of the desired size and he regulated the entrance of both fresh air and chill from below by the rapidity with which he permitted the warm air to escape at the peak of the roof.

The first Eskimo house in which I lived the winter of 1906-07, just east of the delta of the Mackenzie River, had a roof ventilator that was about four or five inches square. When I climbed on top of the house, and held my hand above this ventilator, the blast of air was so strong that I felt as if my hand were being pushed upward. The cold air that compensated for this warm blast entered through a door in the floor, a trap door that was about four feet wide and seven or eight feet long. This door was never covered. There was no perceptible draft as the cold air welled up into our sod house.

One reason then why Northerners like the North is that their houses are comfortable in winter. One of the reasons why the Eskimos like winter even better than Europeans do is that they live in houses that are better designed than ours for cold weather. One reason they dislike the summer is that they have not developed any summer dwelling that deals with the climate as satisfactorily as the winter house.

CLIMATE, CLOTHES, AND COMFORT

The chief reason why Northerners are comfortable in winter is that their dress is sensible; Eskimos are more comfortable than Europeans in cold weather because they are more sensibly clad. Essentially, comfort is not obtainable as long as you dress Euro-

pean-style—tucking your shirt inside of your trousers, wearing overcoats and caps, things of that sort.

In Alaska white people dress more or less European-style, though they have developed some attractive and comfortable skiing and skating costumes that seem in part local. The Royal Canadian Mounted Police, who have to travel in every weather and are on the average sensible anyhow, have in the main gone over to the Eskimo way.

You would get the difference strikingly if you were to compare the so-called parka of a leading Nome business man with the skin coat, or attigi, of the Mounted Police.

The Nome business man tells the Eskimo how to make the parka. First it must be buttoned down the middle of the front—that was in the old days; now they want zippers. Next it must have a lining, and finally a hood that comes forward like a poke bonnet. This leads to a coat that has the following disadvantages, among others:

It is not possible to prevent the formation of hoar frost between two layers of clothing in extremely cold weather. If these layers are separate, so that you can remove them one at a time, you can brush the hoar frost from the inside of the outer one and from the outside of the inner one. But if the two layers are sewed together, as when you have a lined coat, hoar frost will gather where it cannot be brushed off and so remains to melt.

If there is no chance to dry your lined coat, it becomes wet and stiff with ice after a few days, gaining steadily in weight as it decreases in warmth and comfort to the wearer. If you are able to apply artificial heat, then in addition to the bother, you risk decay of the skin through insufficient drying, or scorching it and making it brittle through too rapid drying.

During my first Arctic winter I had a coat which I bought from Roald Amundsen, whom I met at Herschel Island as he was leaving the Arctic from his first expedition in 1906. This coat was to a certain extent designed on what are now called

parka lines, for Captain Amundsen had instructed the Eskimos in how to make this coat for him. It had a poke bonnet hood.

The Eskimo family with whom I was staying advised me against using this sort of hood except in comparatively warm weather. They said that on a very cold day my breath would freeze on the inside of the hood, icing it up so that when I turned my head it would be in contact with ice rather than with fur; and, besides, moisture from this ice would be difficult to dry out in the evening. Nevertheless I used the coat on a journey. What the Eskimos had foretold did happen, and the trouble was worse confounded through my disobeying another of their precepts—to be clean-shaven; I wore a beard.

Not merely did the hood become iced up, but it froze fast to my beard. The snow of the blizzard caked in my beard and on my face. I could not take off the hood because it was frozen to the beard, and I could not get underneath the beard with my fingers to thaw my skin because of the ice mask in the beard.

When we finally got to a house, my face was frozen all over; in one spot, on my chin, it was "frozen to the bone." Whether or not this was literally true, it gave me the only frostbite scar that I have from something like fifteen thousand miles of travel afoot during ten Arctic winters.

The hood of the typical Eskimo coat (as it was everywhere throughout the Arctic before white men began to create fashions, and as it remains, fortunately, throughout large districts where Europeans are few) was so cut that it came just in front of the ears, protecting them but not the cheeks or chin.

The merits of the Eskimo type of hood are most obvious in extremely cold weather. The forward-projecting hood of the European type, even in the most intense cold, holds a sort of warm pocket of air in front of your face. This keeps your breath so warm that it turns into a damp and sticky hoar frost that forms ice on the inside of the hood if the temperature is anything like 40° or 50° below zero. The Eskimo type of hood

will not ice at all, for there is no pocket of warm air; your breath condenses into hoar frost particles, in the extreme cold, before it gets as far from your nose and mouth as the distance to the edge of the hood, three or four inches away. Whatever gathers on the fur at that distance is dry as dust; you brush it off now and then with your mittened hand.

Another mistake Europeans commonly make is to try to keep their faces from freezing. To an Eskimo it seems as foolish to object to moderate frostbite of the face as it does to us to worry about such a slight sunburn as we may get from walking outdoors on a July day in New England.

If the whole of the rest of your body is warm (and it is if you are properly dressed) you can walk all day at 40° below zero with both hands bare, both of them comfortable and the fingers nimble enough to tie or untie knots. If a wind is blowing you may have to put on mittens; you certainly will have to if it is a strong wind.

Wind or not, your face may freeze. As you walk you make grimaces; a newcomer finds that on the second or third day he does it without thinking. When a part of the face feels stiff you investigate with your finger tips, and if the skin is hard, showing it

is frozen, you hold the palm of the hand against it for about thirty seconds. When you take your hand away you feel again with your fingers and, if there is still a little stiffness, you apply the palm a second time. You do not rub or pinch for in that way you might rupture frozen tissue.

If you apply the hand soon enough, as on a cheek when the spot is as yet only the size of a dime or a nickel, your skin will not even peel; in the evening when you camp you will have no such slight burning sensation as you do from a mild sunburn. But if you are careless, and if the frozen spot gets as big or as thick as a half dollar, it will take a little longer to thaw out, and the skin will peel after a few days—without pain, however, as with a moderate sunburn. It is only when frost is deeper than this that considerable pain is involved, with suppuration and a possible scar.

The Alaska business man is uncomfortable when he travels in his costly parka and other gear that has been made at his direction. The total weight of his gear, if he travels by dog team, as they did until recently, from Nome to Fairbanks, will be something between twenty and twenty-five pounds. The sleeves of the coat are stiff, so that he will be handicapped if work is needed; the legs of the trousers are stiff and will tire him as he walks.

By contrast, the Royal Canadian Mounted Police equipment will weigh about ten pounds, less than half of that of the Alaska and Yukon Territory business man. Everything in it—including socks, mittens, underwear—is made exclusively of caribou skin. But if there is a chance that it will be necessary to go through open water or walk on salt sea ice, some modifications are essential. For protection against salt on sea ice you need soles of sealskin instead of caribou on your boots; for protection against water you must have the entire boot made of sealskin or of greased caribou skin with the leather side out.

During one of my northern expeditions I had occasion to travel with a party of Police from Herschel Island to Fort McPherson,

about 200 miles of walking at between twenty and thirty miles a day. There was in our party a constable who was on his first journey and who had not been wearing Eskimo clothes more than a few weeks, and then only around the barracks. But this constable followed the instructions of the Inspector in charge and the Eskimos who were members of the party.

He appeared to me just as comfortable as any of the rest of us, though it was his first trip. I remember, for instance, one occasion when we stopped for a "spell," which meant for about half an hour of smoke and chat. It was an intensely cold and therefore perfectly clear and calm day, probably around 40° below zero. The constable seated himself on a log or a chunk of ice, laid his fur mittens on the snow, took out his pipe and a plug of tobacco, whittled the tobacco slowly, rolled it in his hands, stuffed it down in his pipe and smoked, so far as I remember not putting on his mittens at all while we were sitting there. He did not do this because he had been told it was safe; he was just so comfortable that he forgot where he was.

HARDENING YOURSELF TO COLD

Perhaps the notion that you can harden yourself to cold weather is another deduction from the idea that like is cured by like. More probably it results from our general attitude that cold should be fought.

Certainly it is possible to harden yourself to cold in a mental sense.

The great Norwegian explorer Fridtjof Nansen, having grown up in Norway where winters are never very cold, thought that it was possible to harden oneself to cold. Moreover, he did not understand how to build a snowhouse to have a warm and comfortable camp, nor how to keep his clothing dry. On his 1893-1896 journey, Nansen was so cold in his winter camps, when he was traveling over the sea ice after leaving the *Fram*, that he and his companion Johansen were almost numb in the mornings when

they bundled up their gear, rolled up the tent and started hitching up the dogs. Nansen tells us that frequently before they could begin to harness the dogs they had to start running, wrestling, jumping up and down to "get their blood in circulation." In extreme cases it took them one or even two hours to hitch up the team, when it should have taken not more than twenty minutes.

That Nansen did not use Eskimo technique was because the only Eskimos he knew, those of middle western Greenland, do not understand how to build snowhouses, and indeed know very little about traveling. Neither could he learn much from previous explorers. Dr. John Rae had lived in comfort while exploring in the Arctic, but he was rather looked down upon as having gone native; and the books of Charles Francis Hall were not highly regarded. It was only after Peary's *Secrets of Polar Travel* was published in 1917 that it became feasible to learn from books how to be comfortable in the Arctic.

In contrast with Nansen, I had the fortune on my first expedition to be compelled by circumstances to do what I hope I might have wanted to do anyway, to live as an Eskimo in a snowhouse dwelling with the Mackenzie River people. So we learned Eskimo methods and used them later when traveling under the same conditions as Nansen and at about the same temperatures. We used snowhouses with doors that were never closed, where ventilation and warmth were controlled by gravity. If we heated these temporary dwellings incidentally while cooking supper, our body warmth, even with good ventilation, kept them above freezing thereafter, no matter how cold it was outdoors, so that water did not freeze at night while we slept.

When cooking breakfast in the morning our house was additionally warmed from the primus stove or seal oil lamp. It was so warm that we sat stripped to the waist in the greatest comfort while eating breakfast. We slipped on our coats just before going out; and, with our bodies at just the right temperature, we hitched up our dogs without the use of mittens. We were not numb and

so we had the full use of ten fingers. Normally we would hitch up in anything between fifteen minutes and half an hour, and were on the road before we had been outdoors long enough to be chilled.

TIME LAG BETWEEN EXPOSURE AND CHILL

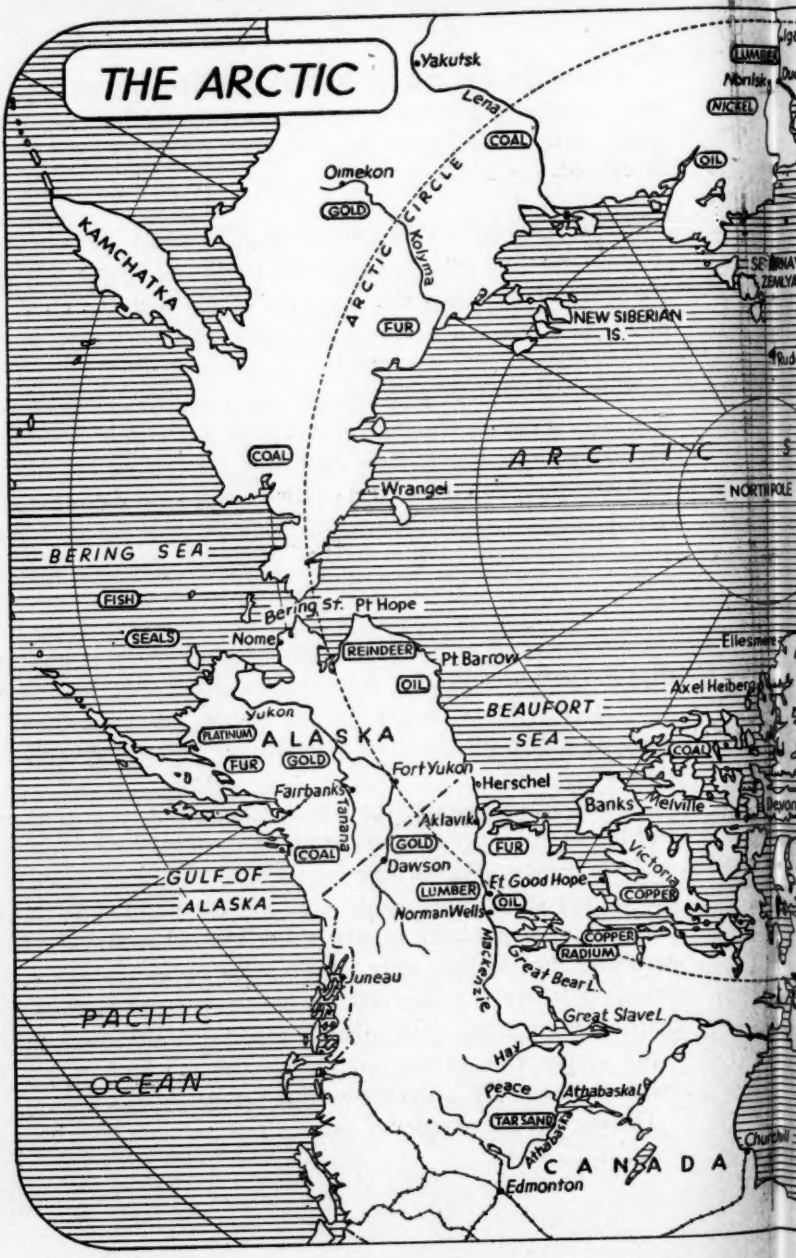
Among the physiological principles that are little understood is the time lag between the exposure of the body to chill and the chilling of the body. You can gauge this most accurately with small children that are naked and whose bodies are exposed to intense cold. In fact you cannot help doing this, at least roughly, if you ever travel afoot in winter with a group of Eskimos. You are likely to be shocked the first time you see an Eskimo mother handling her baby naked out of doors on a cold day.

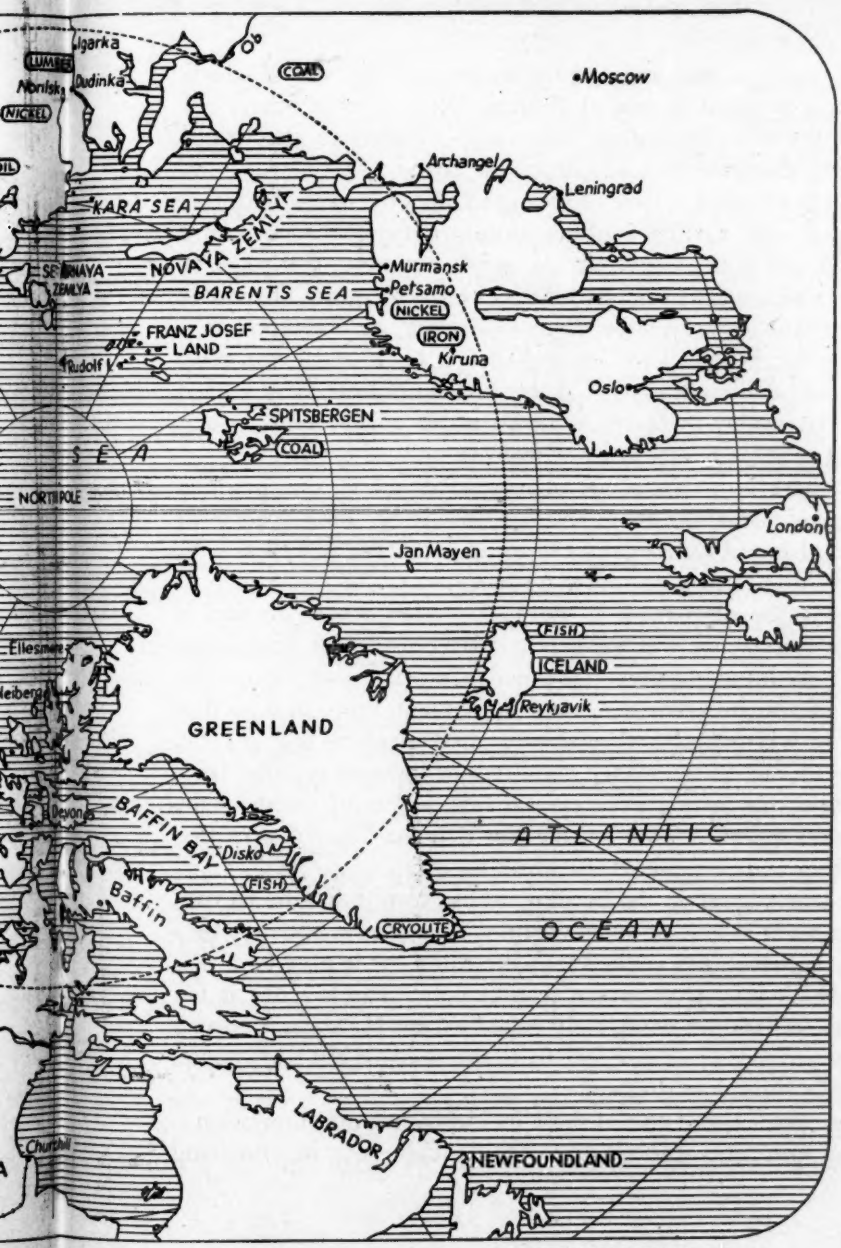
If a child in an Eskimo traveling party is less than a year old, and sometimes even if it is two years old, the mother strips it naked just before going outdoors and shoves it inside of her coat, supporting it on her naked back with a belt that goes up over her breasts in front and down underneath the child at her back, so that its legs are sticking forward on either side just above her hips. As she does this, the mother throws back the hood of her coat, to secure for the child a breathing channel up between her shoulder blades.

As she travels along, the mother herself may get overheated and this is still more true of the child, so that every now and then it starts crying. Then a halt is called. The mother spreads a skin out on the snow, loosens her belt, lets the child slide down, and places it upon its back on the skin. This is irrespective of temperatures, but is done only in still weather or under a moderate breeze. If there is a blizzard, the method is not feasible, for the drifting snow would melt against the child's skin, making it wet.

At a temperature like 40° below zero, which is 72° below freezing, the naked child shows three stages of reaction.

During the first stage, of only a few seconds, the baby keeps


THE ARCTIC
Yakutsk
Lena
COAL
OIL
NICKEL
LUMBER
Olmekon
GOLD
ARCTIC CIRCLE
Kolyma
KAMCHATKA
FUR
NEW SIBERIAN IS.
COAL
ARCTIC
Wrangel
NORTH POLE
BERING SEA
FISH
Bering St.
Pt Hope
SEALS
Nome
REINDEER
Pt Barrow
OIL
Ellesmere
Axel Heiberg
BEAUFORT SEA
Yukon
PLATINUM
ALASKA
FUR
GOLD
Fort Yukon
Herschel
Fairbanks
Banks
Melville
Aklavik
GOLD
FUR
Victoria
COAL
Dawson
GULF OF ALASKA
Ft Good Hope
COPPER
LUMBER
OIL
Norman Wells
COPPER
RADIUM
Mackenzie
Juneau
Great Bear L.
PACIFIC
Great Slave L.
OCEAN
Hay
Peace
Athabaska
TAR SAND
Athabaska
CANADA
Churchill
Edmonton



GRAPHIC ASSOCIATES

its eyes nearly closed and has on its face an expression which might be construed as one of distress; but Eskimo mothers tell me that the eyes are merely becoming adjusted to the bright light, after the pitch darkness inside the coat.

The eyes adjusted, a look of pleasure comes over the child; for, as we have said, there is nothing more gratifying than exposure of overheated skin to cold air. At 40° below zero, this stage of pleasant reaction lasts some twenty or thirty seconds. Thereafter the child will begin to show signs of discomfort. The mother is watching for this, picks it up and slips it back under her coat. She would be thought careless if she waited until the baby started to cry. However, there seems to be no ill effect even in such cases, up to at least some ten or fifteen seconds of crying.

That there is no racial peculiarity involved in this practice is easy to demonstrate from the fact that it has been used with children of mixed Eskimo and European parentage as well as with white children, and with uniform success.

On long journeys made in dead of winter, where no fuel is available for drying wet garments, it is necessary to sleep completely naked; for it is universal experience that if you wear night clothes of any sort they will imprison enough body heat so that hoar frost will form between them and the sleeping bag or robe. Even when out on the sea ice, hundreds of miles away from land, we follow this principle except on rare nights of terrific gale, when we keep our clothes on for fear that the floe will start disintegrating and necessitate our breaking camp.

We always agree in the evening whose turn it will be to rush out that night in case of an emergency. The emergency may be a polar bear which has walked into the camp, or it may be a dog fight, which it is necessary to stop at once. The practice is for one man to dash out completely naked except for shoes, grasping his rifle or whip as he emerges from the door of the snowhouse, the others meantime dressing.

I have never timed any of these incidents, but my impression is that the men who stop to dress usually come out in something

between twenty and forty seconds, whereupon the first man goes back into the snowhouse. If the disturbance is caused by a polar bear, it usually takes less than thirty seconds to kill him when the visibility is good. Dog fights take longer.

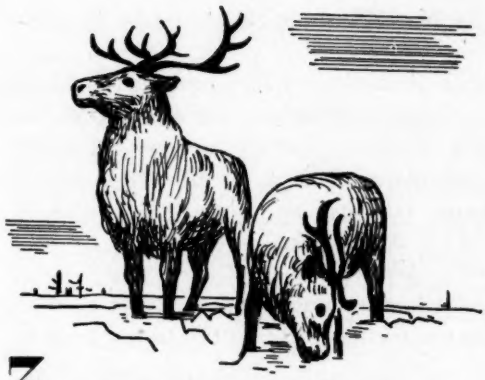
No doubt it is for reasons analogous to these that all northern people who are not swayed by theory live in warm houses. Roughly speaking, the houses get warmer as the winter gets colder. In the northern United States, where outdoor temperatures fall much lower than in Britain, indoor temperatures are some ten degrees higher than in England. In southern Canada houses tend to be warmer than anywhere in the United States. Captain Robert A. Bartlett has reported from the north coast of Siberia that the dwellings there were kept in winter at a temperature above 100° F.

On the western Arctic coast of Canada, as we cooked supper and just afterwards, the temperature was ordinarily in the vicinity of 90° F., no doubt occasionally going up to 100°. This is something like our idea of a Turkish bath. Such heat does not permit much clothing. (In Greenland, before European "modesty" came along, it is said that men, women and children sat completely naked. In northwestern Canada and northern Alaska only children were wholly naked; the men and women wore knee breeches, so that they were stripped from the waist up and from the knees down.) The perspiration ran down our bodies in great streams constantly, and we drank large quantities of cold water to make up for the loss. The temperature was allowed to drop as bedtime approached, around nine or ten o'clock, and we slept under light covers. This was, of course, in houses of earth and wood; snowhouses can be kept that hot only if fur-lined. Unlined, snowhouses are kept around 50° above zero if it is 40° below outside.

THE CARDINAL NECESSITIES

These sketchy remarks on what the Arctic is not, and on what our attitude towards it should not be, are presented in the belief that it is a first necessity for developing the northern regions of

America and Asia that the colonists shall get away from European ideas. They must renounce the thinking that is behind such folkways as rubbing snow on frostbites, refraining from snow-eating when thirsty, wearing lined garments, tucking shirts into trousers, trying to harden oneself to cold. In general, they must get away from the idea of fighting the environment. They should borrow all the methods now available of adaptation to climate and other environmental conditions. They should build up a way of life that has adaptation rather than struggle for its keynote.



THE REAL PROBLEMS

3. North to Everywhere

Most important for the development of the Arctic is the right approach. Next in importance is to know what it is we are approaching. This requires an understanding of the location of the Arctic with relation to countries which are already developed and powerful, and then a grasp of its nature.

THE ARCTIC LIES ON THE ROAD TO CHINA

We have remarked the curious fact that the shape of the earth and the location of the Arctic were better understood from the time of Columbus to the reign of Queen Victoria than they have been since, unless we except perhaps the last five years. Under war stimulus, we are now returning, in a measure, to a view of the northern half of the earth similar to that which was common during three centuries preceding.

We have mentioned what the Admiral of the Ocean Sea believed, that those are equally wrong who consider the tropics too hot and the Arctic too cold for the use of mankind. It is another part of the Admiral's story that he left behind a memorandum to the effect that when he was through with his voyages to the Indies westward from Europe, he was going to make a journey

to the Indies by way of the North, because this might be an easier and better way of reaching China.

There were three variants of this idea, which took firm hold on the thinking of navigators and geographers: to sail around the north of Asia through the Northeast Passage, around the north of America through the Northwest Passage, or directly north by way of the geographic pole.

SEEKING A NORTHERN SEAWAY

It is doubtful that history will show a case more subject to wish thinking than the long search for a passage to the Indies by way of the North.

South and east around Africa the road to China was long; it was long by the south and west around the Horn. So it was obvious that the short way to the Indies is by the northern route. Governments and navigators were so set on this belief that failure after failure was explained away with an ingenuity and success which now seem hardly credible.

Thousands of lives and millions in treasure were spent by the European nations in attempts to find a direct route to China by way of the Pole; or indirect ones, the Northeast and Northwest Passages around the continents of Eurasia and North America. The leaders were two nations, Britain and the Netherlands, but there was much contributory work by others, as, for instance, the series of ventures known as the Great Northern Expeditions of Peter the Great.

The Great Northern Expeditions, with those which preceded and followed, brought to Russia the credit for unveiling the whole northern shore of the Old World mainland, with the discovery of Bering Strait and of northwestern North America. The finding of the Northeast Passage, in the sense of determining that there is a continuous ocean around the north of the Old World, well on that side of the Pole, was, accordingly, made some two hundred years ago. The corresponding discovery for North

America was completed by Thomas Simpson just over a hundred years ago.

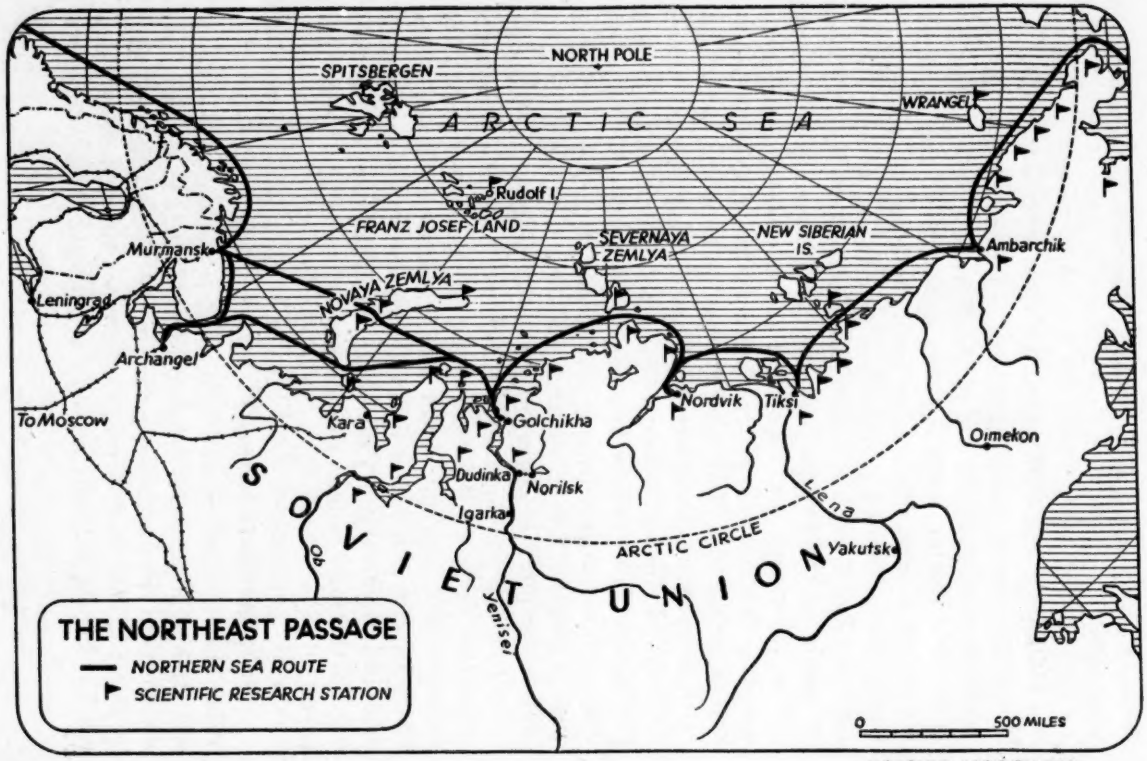
BLOCKING THE NORTHERN SEAWAY

There does not appear to have been in Europe or Asia any concerted opposition to the use of the Northeast Passage; but it is fairly clear that in North America opposition to the use of the Northwest Passage, the seaway from the North Atlantic to the North Pacific, started more than a hundred years ago. For the Hudson's Bay Company, which had promised the British Crown to search for the Passage, has never been successfully defended against the charge that they were not merely lackadaisical but definitely hostile from policy. Hudson's Bay Company opposition to the use of a Northwest Passage has been said to be based on their fear that if there were a successful water highway around the north of America it would promote colonization, bringing in farming and other typical European activity; this, they thought, would destroy the fur-bearing animals and thus ruin the business of the Company, which was exclusively fur trading.

More recently, opposition to the use of northerly seaways has come from the transcontinental railways of Canada, and from the population centers of Canada along its southern margin. The feeling now is that any direct ship traffic from Europe to the China-Japan region will decrease the revenues of ocean terminal cities like Montreal and Vancouver, decreasing likewise the earnings of the railway lines that connect Atlantic and Pacific seaports.

THE NORTHEAST PASSAGE

While there was no opposition to the development of the Northeast Passage, little was done about it until there came into force the northern developmental policy of the Soviet Union, handled by the Administration of the Northern Sea Route, formerly centered at Leningrad, more recently at Moscow. This Administra-



GRAPHIC ASSOCIATES

tion controlled a territory which in extent is equal to perhaps two-thirds of the United States. The powers and policies of the Northern Administration have been described as a combination of those of the Canadian Hudson's Bay Company and the United States Department of the Interior. Some aspects of its work were subject to Army and Navy control, for the Soviets considered the northern route important as a source of military strength.

Through establishing on northern promontories of the Eurasian mainland, and on northern islands, a network of scientific research units called Arctic Stations, there has come not only a broad increase of general knowledge but so great a specific progress in the arts and sciences that bear on northern transportation that the Northeast Passage is now, beyond the dispute of anyone who has studied it, a material element in the strength of the Soviet Union. The chief factors that made this success possible are the network of weather-reporting centers, which furnish information that enables far more accurate weather forecasting than could otherwise be attained—and ice scouting with airplanes. A third element, most publicized but probably of least importance, is the building and use of powerful ice-breakers.

Under the Soviet procedure, you forecast not merely the weather but also the ice conditions. From the reports of planes and stations you know where the ice is today, its character, speed of movement and direction. You know there are currents in some places and not in others. You can infer certain things from a knowledge of the past that help you to determine seasonal ice behavior. Then you have wind prognostication for several days, naturally with decreasing accuracy the farther you try to look ahead. Still, roughly speaking, you can tell on a given day not merely where the ice is but also, with near certainty, how it is being moved under the combined influence of wind and current, where it will be tomorrow, and perhaps where it will be day after tomorrow.

This knowledge brings into practice a method of navigation

common a hundred years ago, in the great days of sail. The skipper would then go 1,000 miles out of his way, if necessary, seeking favorable winds and drifts, avoiding regions of calms, the doldrums, and contrary winds or currents. Those who used that method with skill came to the end of their voyage sooner than others who tried bull-headedly to go by the shortest route, ignorant of how to adapt themselves to the wind and the sea.

The like procedure is followed in Soviet practice. A vessel may steer direct for where there is today a patch of ice, in the knowledge that tomorrow or the next day, when the ship gets there, the ice will have gone off somewhere else. Although the secondary help of the ice-breaker may always be necessary under certain circumstances, it is destined to be of proportionately less and less value as careful reporting and skillful forecasting develop the ability of the commander to avoid the ice or to pick his quarrel with it in such a way as to make the contest less difficult.

THE NORTHWEST PASSAGE

Before the Soviets developed the Northern Sea Route it was commonly believed that the Northeast Passage was more difficult than the Northwest Passage. With the success of the Northern Sea Route the reverse opinion has gained headway—that they are fortunate and we unlucky in that the passage around the

north of our continent is more difficult than the one around the north of the Old World.

Careful weighing of all we know of both passages will show that the earlier view is the more likely to be correct. We are conservative if we say that, although mile for mile the difficulty may average about the same, the difficult mileage for us is less than half the difficult mileage for them. Our great advantage over the Soviets is that to the north of America are islands that hinder and direct the movement of the ice, while north of the Old World the islands are comparatively few and small, so that there are vast stretches of coast where the wind may bring the ice of the whole offshore sea down upon you at any time. Since Soviet vessels have succeeded in making the arduous round-trip voyage from Murmansk or Archangel around the north of Siberia to Petropavlovsk or Vladivostok and back again in one season, it ought to be possible for us to make two round trips a year between the North Atlantic and North Pacific.

The most difficult stretch of our Passage is from Herschel Island, in Beaufort Sea off northwestern Canada, to Bering Strait, for the Alaska north coast is not sheltered by islands and presents the same problems as the Siberian coast. But this is exactly the segment of the Passage that has been in constant use since 1889, when whales were discovered in the Beaufort Sea; there was lots of money in whaling and in the heyday of the industry many vessels were attracted to these waters. Since then not a year has passed when a vessel could not work along the north coast of Alaska; but there have been hard years.

The beginning of our Northwest Passage, looked at from the Atlantic, is Lancaster Sound. Sir Edward Parry had no serious difficulty navigating that Sound the first time it was ever tried, in 1819, when he went as far as the middle of the south coast of Melville Island, where he spent the winter. Since then for more than a hundred years the records do not appear to show any case where a vessel, whether under steam or sail, attempted to reach Melville Island from the Atlantic and failed to do so.

GRAPHIC ASSOCIATES

Of great importance to transportation, is the fact that in the Beaufort Sea, to the west of Prince Patrick and Banks Islands, the winds in summer are prevailingly from the north, northwest or from some westerly direction, and that therefore what amounts to a current flows east through McClure Strait, between Prince Patrick Island and Banks Island.

As a result, that strait is most of the time jammed with the heaviest ice that has ever been reported from any part of the northern sea. Nevertheless, the only ship that ever tried to go through McClure Strait, McClure's *Investigator*, did make it as far as the Bay of Mercy, through what looks on the map as if it were the most difficult section.

It is a simple law of nature that when ice is crowded through a narrow strait by wind and current, and when it emerges into a wider space, such as Melville Sound, it slacks out because there is more room. Instead of the floes jamming and crushing each other, they drift placidly, with lanes of open water between them—the so-called sailing ice, in which a ship can make its way under sail by appropriate steering and tacking.

It has been my view, at least since 1915 when I first crossed Melville Sound afoot during the spring, that it would be easy in summer to cross by ship from Melville Island, where Parry and so many after him have wintered, to the northern end of Prince of Wales Strait that separates Banks Island from Victoria Island. In the summer of 1916, men of our expedition sat on the hills of southwestern Melville Island, near Cape Providence, watching for a ship of ours which was supposed to come but which never tried to come (for reasons explained in my book *The Friendly Arctic*). It appeared to these watchers, who could see all the way across to Banks Island, that the ice was so scattered that the ship would have had no difficulty in getting through, had she tried.

Our ship would have been the first to succeed if she had attempted it. The first vessel to try was the *St. Roch* of the Royal Canadian Mounted Police and she was successful.

The *St. Roch* made the voyage in sixteen days from Baffin Bay through Lancaster Sound, Melville Sound, and Prince of Wales Strait to the waters off the Mackenzie, without difficulty. Inspector Larsen (Captain Larsen on his ship) tells me he is convinced the theory is correct which holds that the very fact of the ice crowding eastward through McClure Strait makes for comparatively open water during much of the summer in the western part of the sound.

From that part of Melville Sound which since 1819 has been reached every time anyone has tried, a crossing can therefore be made easily most or all summers, southwest to the northern end of Prince of Wales Strait. That strait has been observed through many seasons as usually free of ice in summer although there have been occasions of temporary jamming—for instance, in the early autumn of 1915 when I tried to take the *Polar Bear* north through this strait and was not able to proceed on September 4 beyond Armstrong Point. Had we been two days earlier we probably would have had no difficulty in getting into western Melville Sound, and thus to Melville Island.

FIVE ROUTES THROUGH THE NORTHWEST PASSAGE

Captain Larsen says that the *St. Roch* had most trouble between the Mackenzie River and Bering Strait and that he is convinced this sector is the most difficult part of the Northwest Passage, particularly the part of it between the Alaska-Canada boundary and Point Barrow.

In a memorandum I wrote during the early part of the war, for possible use by our armed forces, I described five ways of passing through the Canadian Archipelago—the five main Northwest Passages. I gave as easiest the Lancaster Sound-Melville Sound-Prince of Wales Strait-Herschel Island route, which the *St. Roch* used; next easiest, the one followed by Amundsen, south along the east coast of King William Island and then west; third the route used by the Hudson's Bay Company, which passes through

Bellot Strait; fourth and fifth, and both in my opinion tricky, the variant of the Amundsen route which passes west instead of east of King William Island, and the variant of the Larsen route which passes north of Banks Island instead of along its east coast. Captain Larsen, who, after all, has been navigating portions of these waters for nearly a quarter of a century, agrees with me that my preferred route is the shortest, the deepest, and generally the easiest; but he thinks that the Amundsen route, which I placed second, is one of the poorest.

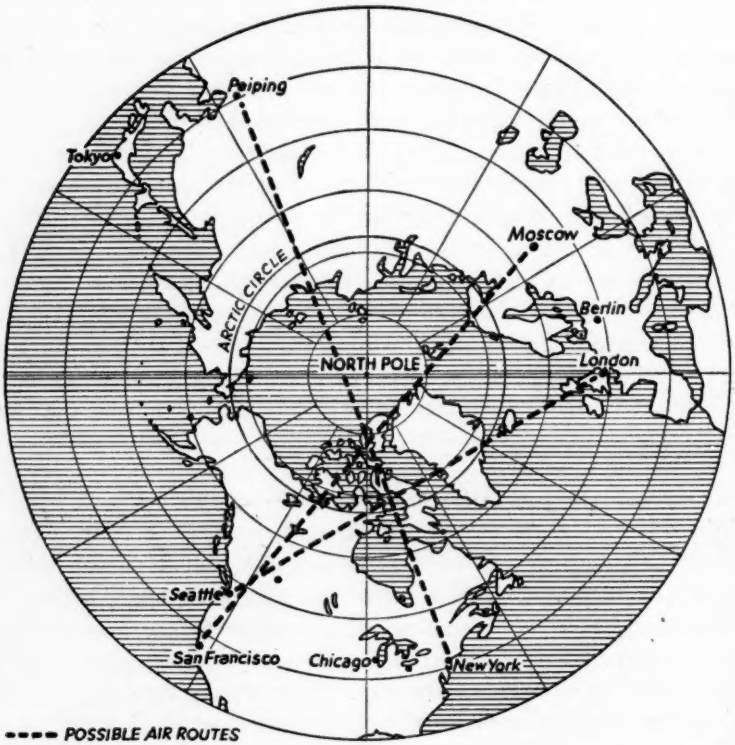
One of the main steps, then, in Arctic development during the next few years can be our use of the Northwest Passage somewhat as the Soviets are using their Northeast Passage. Whether we do this will depend upon national policies of the United States and Canada—particularly upon the setting up and operating of a thoroughly modern and somewhat elaborate weather and ice reporting system.

THE GLOBAL OUTLOOK

There is no concerted opposition to the use of airplanes in the Arctic, so there is no serious aeronautical handicap to our northward development. The transportation part of our problem is therefore chiefly concerned with seaways, roads, and railways.

Most of us have been saying with increasing frequency since 1939 that the earth is spherical, and that we are fighting a global war. In another five years it may come to be favored as a national policy, both in Canada and the United States, that full use shall be made of the earth's roundness. Still, to expect this is perhaps a bit optimistic. We have been thinking so long in terms of east and west crossings of oceans and continents by ship, road, and rail that it is not going to be easy for us to apply great circle concepts to railways as well as airways, and to realize that we need not cross wide oceans to reach most of that 90 per cent of the world's population which is north of the equator.

It is hard for practically all of us, who were schooled on



geographies crammed with Mercator world maps, to see steadily in our mind's eye that England is north from Alaska and Chicago north from Calcutta, with the northward routes the shortest. In trying to break myself of flat-earth thinking I have found it useful to repeat to myself that there is no Pacific Ocean between us and China, and that it is the Arctic Sea, not the Pacific Ocean nor even the Bering Sea, that a long-distance plane would cross

if it started from Peiping for a non-stop flight to New Orleans. It is not the Atlantic Ocean but the Arctic Sea that a plane will cross in flying direct from San Francisco to Moscow.

Perhaps as good a way as any of jarring ourselves loose from the east-west concepts based upon a flat or cylindrical earth, is to say to ourselves often and firmly that the capital of every powerful nation in the world is nearer to the Arctic Circle than it is to the equator, and that these capitals are arranged approximately in a circle around the Arctic, so that the center of the curve formed by lines joining them will lie within the polar basin.

THE GREAT POWERS ARE SUB-ARCTIC

Put a string on your globe, holding one end with a finger at the North Pole and moving the other from capital to capital of the Great Powers; or, if you prefer, from industrial center to industrial center. New York is a good deal nearer to the Arctic Circle than to the equator, and San Francisco is a bit nearer. Tokyo is nearer the Arctic, and so is Peiping, which most people seem to think will again be China's capital when the war is over. The great Asiatic cities like Irkutsk and Novosibirsk, the Chicago of Siberia, are also closer to the Arctic, as are Moscow, Berlin, Paris, London, Montreal, Philadelphia, Detroit, Chicago, Seattle, and Washington.

Since these foci of power are arranged on or near a curve that has its center within the Arctic Circle, it follows that if you shoot robot bombs (as Heaven preserve us from ever doing), they will cross the Arctic on their way from London to Seattle, from Peiping to New York, from San Francisco to Moscow. That is the way the bombers will fly, if we ever permit them to; so will the transport planes, which carry business men and others who are in a hurry and who cannot afford to stop in New York when on their way from San Francisco to Paris—a digression of several hundred miles that is costly in time and still more costly in gasoline and wear and tear on machinery.

ARCTIC FLYING CONDITIONS—GOOD AND BAD POINTS

It is now an antiquated idea that flying difficulties grow steadily the farther you move from the equator. They do increase from the equator until you reach the places where there is the greatest amount of weather per year that hovers around the freezing point. For in that temperature range you find the densest fogs, sticky snow and sleety rain that interfere with visibility, weigh down an airplane, and tend to build up ice on wings and propellers in such a way that the aerodynamics of the plane are changed, its performance decreasing rapidly until it goes out of control.

Theoretically at least, we were over the hump of this belief by 1930, when Dr. Willis R. Gregg, later Chief of the United States Weather Bureau, explained in the second edition of his *Aeronautical Meteorology*, that the average flying difficulty within the Arctic, taken the whole year through, is less than in the northern half of the north temperate zone. Now the northern half of this zone begins in our country in Ohio, where the airplane was invented; in Europe it begins south of Milan. There certainly has been a good deal of flying the last few years north of Dayton and north of Milan.

Take a specific case: It was agreed by most students of aviation (before blankets of military secrecy descended upon new inventions and techniques around 1940) that the average difficulty on an air line from Philadelphia to Cleveland would be greater per year than the average difficulty of a line starting in Philadelphia, passing through Cleveland, and then crossing by way of the North Pole to some town in Siberia. There will not be, in fact, so far as we know, any segment of that line as difficult as the one from Philadelphia to the Arctic.

THE NORTHWARD COURSE OF AVIATION

It is tedious, particularly for persons who have followed the history of northern flight, to read statements in 1945 which were

startling seven or eight years before. We review them nevertheless:

Around 1938 the air lines of Alaska, serving a population of 80,000—about 40,000 whites and the rest forest Indians and prairie Eskimos—were carrying about 80 per cent as many pounds as we in the States carried in the service of the more than 130,000,000 people who live between the Rio Grande and the Canadian boundary. In the same year more pounds were carried by air in the northern half of Canada, for less than 100,000 people, than were carried in its southern half for more than 11,000,000. (That was, of course, before the initiation of the Trans-Canada air service of the Canadian National Railways.)

If the northward progress of aviation was startling in North America, it was more remarkable still in the Soviet Union.

During the last year for which we had figures before the war, there were in Alaska and northern Canada less than twenty different airplanes, making less than a hundred flights per year north of the Arctic Circle; for most of the traffic described above was in the southern two thirds of Alaska and in the middle third of Canada. So far as we have been able to find out, the total North American mileage flown north of the Circle in 1939 was probably much less than 100,000 passenger miles. That year there were more than a thousand different Soviet airplanes which operated most of the time beyond the Arctic Circle, flying no doubt dozens if not scores of millions of passenger miles.

In Canada, ox teams were flown to sub-Arctic mining operations; in Alaska, mining machinery weighing several tons a piece was delivered by charter flights. But in such things, also, the Soviet Union led.

Minerals considered important for the war, which the Soviet Government realized was coming, had been discovered at Norilsk, about 70 miles east from Dudinka on the Yenisei and more than 200 miles north of the Arctic Circle. It was decided to build a railway from the mines to connect with steamboat traffic on the

river. Supplies were taken by river boat to Dudinka, opposite Norilsk. It was felt that time would not permit building the road in one straightaway from the river to the mine, and that it would have to be built in a number of segments—from Dudinka, from Norilsk, and from intermediate points. According to the reports, they flew in not merely workmen, food and equipment; they even flew in rails and ties, dropping them at the segment points, permitting construction both ways from several of them.

It appears to be a military secret just how many people there are now at Norilsk, but reporters have been permitted to intimate (for instance, Maurice Hindus in the New York *Herald Tribune*) that the place has developed in five years from nothing to a city even more important, and therefore perhaps larger, than Igarka. Igarka is a lumbering town on the Yenisei, about 50 miles north of the Circle, which had a population of something like 20,000 in 1939. Doubtless Igarka is larger now, for it is a commonplace that cities in the Arctic and sub-Arctic of the Soviet Union have grown anything from 50 per cent to 200 per cent in five years. Therefore in 1945 we might guess that the population of Norilsk is anything from 10,000 to 30,000.

NORTHWARD COLONIZATION

One way of comparing northward development in Alaska, Canada, and the Soviet Arctic is through the size of towns. The two largest towns in Arctic Alaska, if we do not count soldiers and others directly concerned in war activity, are Fort Yukon, which is about five miles north of the Circle, and Wiseman, about 60 miles north of it. Neither has a population of more than 200. There is only one town in Arctic Canada that may reasonably be compared with these—Aklavik, on the Mackenzie, about 150 miles beyond the Circle, with a population of about 200. In the Soviet Union, Igarka certainly and Norilsk probably had populations of more than 20,000 in 1944; and there are many towns ranging downward from those figures. (We do not count Mur-

mansk and Archangel, each with several tens of thousands, for although they are well north of the Circle they depend for some of their importance on the Gulf Stream.)

Northward developments on our side of the Pole, and on the far side, have been conditioned to some extent by governmental policies. It is probably most accurate to say that for Alaska we have had no policy. In Canada there has been a well known, although never definitely announced, policy to discourage the development of population centers in the North that are remote from the thickly settled portions of southern Canada; the favored process is a slow and methodical northward movement of the frontier, leaving no gaps of unsettled country behind.

Thus Canada has recently been retarding her own northward development through the action of a conservative political majority. A similar retardation of westward development was attempted by a political minority in the 1870's under the leadership of Edward Blake. They tried to prevent the building of the Canadian Pacific Railway across the western prairies, on the theory that as Canada still had a good deal of unsettled land in Ontario, Quebec, and the Maritimes, it was foolish to leap ahead toward the Pacific. This was, indeed, parallel to what many wanted to do in the United States between the Revolutionary and Civil Wars, and on the same theory—that it would reduce the prosperity of the eastern states if large numbers were to migrate beyond the Alleghenies, and that in any case it was sensible to develop slowly westward.

The trouble with the Canadian policy has been that slowly has meant very slowly indeed. There are still many who affirm the wisdom of the policy but none who can deny the resulting slowness, shown in a comparison of Canadian northward mileages with those of the Soviet Union.

What the Canadians did with their prairies in spite of Blake's adherents, what the United States did with the Louisiana Purchase in spite of a strong minority, is well known to all of us—

thousands of citizens kicked over the traces to surge westward, stopping to build cities or fleeing farther west before the advance of civilization.

This westward surge was, in our two North American countries, a popular movement. In the Soviet Union the same popular elements seem to be present, in the sense that multitudes are eager to go north. But their northward movement has been governmental, too, in the sense that Moscow desired it and led the way; however, it is said that there are few northward enterprises, whether scientific, exploratory, or commercial, for which there are not several times as many volunteers as the Government can use. We hear also, from newspaper correspondents, that the war has not decreased enthusiasm for the Arctic. To many in the Soviet Union the North is what our West was to us; their pioneers are doing, with the active and systematic help of their government, what our pioneers did with only moderate governmental help, and sometimes in spite of hindrances.

DO IN ROME AS THE ROMANS DO

Naturally you cannot behave in the North of Canada or Siberia as you do when you are on the Niagara peninsula or in the Crimea. Obviously it is necessary to realize when you go from Florida to North Carolina that you must give up orange growing in favor of something like tobacco; if you move from North Carolina to North Dakota you have to change from cotton and corn to wheat and corn. As you go north from the Dakotas, you leave the corn behind though you can take the wheat with you even beyond the Arctic Circle. All southerners have to learn new ways when they move north. Especially, we believe, they should learn how to change their minds.

No mental change is needed the first several hundred miles north from Edmonton. For it has been agreed by those familiar with the subject, at least from the time I made my first journey down north along the Mackenzie in 1906, that potentially one

of the finest mixed farming districts of Canada is the valley of the Hay, which flows northward into Slave Lake, not southward into the Peace valley which the railways already serve. In the Hay you can safely behave as if you were still in Michigan or Quebec.

THE HAY VALLEY AND PUBLIC OPINION

We pause here to consider what may be one of the keys to the success or failure of northward development, both for Alaska and Canada. This is the handicapping fact that Canadian public sentiment, generally speaking, is opposed to extending the railway even the two or three hundred miles that are needed to open up the millions of farming acres that lie just beyond the Peace. When articulate, the view of the opposition is: We are not getting any too much money now for our eggs and bacon, our butter, wool and wheat. Would it be sensible then to open up a new competitive region—for wheat by the million bushels, butter by the hundred tons, to come pouring into our markets, depressing prices that are not any too high now?

ARCTIC MIXED FARMING, FORESTS AND PRAIRIES

Wheat and mixed farming generally have been successful in the Tanana valley, around Fairbanks, which is about 100 miles south of the Arctic Circle, and in a number of other places in Alaska. Wheat can be grown equally far north in Canada. The authorities of the Soviet Union, whom our agricultural experts commonly recognize as nearly if not quite at the forefront of world leadership in this department, generally believe that wheat can be grown even beyond the Arctic Circle in Siberia. This would eliminate the bother of fetching breadstuffs from more southerly districts.

Evergreen forests, chiefly the black and the white spruce and cottonwoods, birches, willows, etc., spread into the Arctic at many points far beyond the Circle, going more than 150 miles beyond it in North America along the Mackenzie and more than 300 miles north of the Circle along Siberian rivers, in some cases apparently more than 400 miles.

Until recently it was commonly thought that special northward extension of cereal crops or a forest were accounted for by warm currents in the sea, particularly the Gulf Stream. The reverse is true. Both spruce trees and wheat crops grow farthest north away from the Gulf Stream or Japan Current. In North America the most northerly extension of both crops and woods is on the lower Mackenzie, remote from the Pacific and shielded from the Japan Current by two ranges of mountains. In the Old World, trees grow 400 miles north of the Arctic Circle on the Lena River, in a district which is about as remote as can be from Japan Current or Gulf Stream.

This extension of forests is usually given on the credit side of the ledger. But for the uses of man the prairies are on the whole more valuable than the woodlands, for prairies grow the vegetation which supports grazing animals that, in turn, give us meat, skins, and, in the case of the sheep and the musk ox, also wool.

4. Northern Domesticated Animals

The possibilities of crop development in the North are readily understood. Therefore, it is more important to discuss the less appreciated northward possibilities of animal husbandry.

FORCING SOUTHERN ANIMALS NORTH

There have been attempts to project domestic cattle into the Arctic; and with success, at least from the point of view of those who take for granted the chores and expenditures connected with stables, hay, and a kind of nursemaid attendance on the animals. The Polar Sea Dairy Farm of Dr. Leslie David Livingstone is rightly a widely-advertised success; it is at Aklavik, in the Mackenzie delta, about 150 miles north of the Circle, in the northern edge of the forest where prairie grasses are available for feed. Soviet

experiment stations have carried domestic animals farther north than have Canada or Alaska, of course with the same handicaps of stabling and feeding.

Domestic cattle should remain a curiosity in the Far North. Sheep can be extended farther; they need less stabling and care. They do well not only in Iceland, but also in Greenland.

THE HORSE IN THE NORTH

The best animal for the North, from our ancient domestic inheritance, is the horse. The Iceland pony and the Siberian pony require neither barn nor hay even in the northern edge of the forest or out upon the northern prairie. To make them a valuable source of food we need only to extend the current practice of continental Europe in the eating of horse flesh. Or we might think of this as reverting to a custom formerly universal throughout Europe; for it was one of the main problems of the Christian Church when it was spreading, for instance through Scandinavia, to persuade the European converts to give up their favorite meat.

THE MUSK OX

In 1919 ex-President Theodore Roosevelt said to a group of us that if he were to choose man's greatest stupidity it would be his insistence upon dragging with him to every part of the world those domestic animals which he happened to inherit from a prehistoric ancestor. We had been bewailing what seems to be a fact —that in historic time European man has adopted only one new domestic animal of consequence, the turkey, and this we borrowed from Mexican Indians. Civilized man himself has domesticated no beast of economic importance.

Roosevelt's favorite example of European man's stupidity had been the eland, which he said furnished meat as palatable to those used to it as beef is to us, and, indeed, palatable at the first taste to most beef-eaters. So in Africa we kill off the eland, which are there already by the tens of thousands, in order to introduce

domestic cattle. Then we discover that the tsetse fly and other pests to which the eland is immune are deadly to the bovine substitute. So we start a campaign against the tsetse fly. This is the old story of fighting nature instead of adapting ourselves.

But, said the ex-President, now he believed that the very greatest of man's stupidities was failure to adopt the musk ox in all sections of the Old and New Worlds which are so far north that our domestic cattle, with their tropical nature, need barns for shelter and hay for feed, which in turn require the purchase of mowers and other farm machinery. There is endless expense and bother incurred in our struggle to force nature to accept these immigrant beasts.

The ex-President based his changed view on the advantages of a musk ox over an eland and, indeed, over our cows and sheep. If a sheep were as big as a steer, it would be more valuable than a steer, for it could furnish wool as well as meat. Similarly, if a steer had wool, it would be more valuable than it is now. But in the musk ox we have the equivalent of a cow with a coat of wool or a gigantic sheep yielding six or eight times more meat.

Incidentally, it is a mystery why this beast is said to have musk and to be an ox, for it has no musk and is not an ox—it looks more like a sheep. The musk name may have been a promotion feature. At the time when northern Canada was first explored, musk, now the base of many of the best perfumes, was used directly as a perfume, and fortunes could have been made out of a musk-producing North American animal.

Explorers frequently have depended on the musk ox for food. The winter of 1916-17 there were seventeen of us in Melville Island living by hunting. During the year we had no food except the lean and fat of animals; something between 80 per cent and 90 per cent of our food was musk ox meat, the rest caribou, polar bear, and seal. The Eskimos in our party, who had been brought up on caribou, at first preferred their accustomed food, but they took to musk ox beef readily as a substitute. All our white men

preferred musk ox to caribou from the start. We seemed to agree with each other that the musk ox was so nearly like domestic beef that you would not be able to tell the meats apart by color, texture, odor, or flavor, but only by the differing shape of the bones. Admiral Peary, who had long experience with the musk ox, held that it is not merely the best flesh food available in the North, but that it is superior to domestic beef. Several members of our combat forces, who have eaten musk ox in northern East Greenland during the present war, agree with this estimate of Peary's.

ARCTIC WOOL PRODUCTION

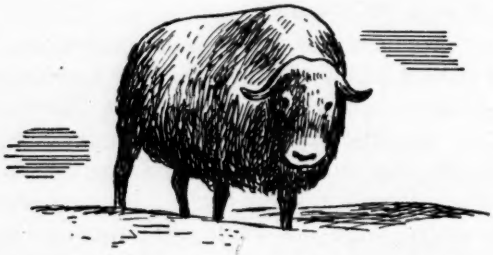
The musk ox produces, per head, about double the meat of a reindeer and at least double the milk. Its hide is probably of comparable value; in wool it is unique for proper Northern animals.

At least two hundred years ago it was suggested by the explorers of Canada that musk-ox wool could be valuable, and garments were made from it that far back. The conclusive studies in this field, however, were not made until the 1920's, when the University of Leeds, England, worked with about sixty pounds of wool through two years. Their conclusions were, among others:

The color of the wool is a soft brown, agreeable to present fashion; bleaching is easy and then you can dye it any color. The fiber is softer than cashmere. The wearing strength is roughly that of merino. This wool has the advantage over all other wools that garments made from it will not shrink, even when washed with hot water and rubbed. It is also warmer for its weight than merino.

There is apparently no necessary southward limit to the range of the musk ox, for at all times of year he prefers grasses and browse to lichens, though he will eat lichens if there is nothing else. He could be a success, therefore, on our western cattle lands. Animals captured and penned up in zoological gardens, in New York, San Francisco, London and Berlin, have not shown a mortality rate appreciably higher than that of cattle. Indeed, there is geological proof that the musk ox once extended as far south as Kentucky.

Almost certainly the extermination of this animal in Kentucky was merely the first or an early chapter in a story which continues to the present. Man is so powerful and ingenious that the rest of the animals have no recourse except to hide or to flee. But the musk ox never learned to hide, and he has always refused to flee. He was mowed down by the arrows and spears of primitive man, by the rifle bullets of the modern hunter. Except in a few places where he is protected by a successful administration of law, the musk ox is now found only where man is not found.



Accordingly musk oxen survive mainly on the uninhabited parts of the north coast and northern east coast of Greenland and in those Canadian islands which are not occupied by Eskimos. The last of them were being killed in Banks Island by Victoria Island Eskimos when I was in Victoria Island the spring of 1911. They were all gone when our expedition occupied base stations in southwestern and northwestern Banks Island and in western Victoria Island, from 1914 to 1917. Hunting crisscross through Banks Island for three years, we lived on game and found only caribou.

From Siberia the musk ox disappeared before the first known Russians got there, and the Russians found none in western Alaska. Charles D. Brower, who has lived at Point Barrow since 1884, reports that the Eskimos told him they killed the last band on the prairie south of there in the 1860's. Ernest Thompson Seton saw one a little north of Slave Lake as late as 1907. There still were

some around northern Great Bear Lake when we were there in 1910-11; a few may still remain. East of the Coppermine there were numbers of them all the way southeastward to the vicinity of Chesterfield Inlet. These are now protected by a law which is not extensively breached.

I began to urge the domestication of the musk ox on Washington through personal meetings with Secretary of the Interior Franklin K. Lane the winter of 1918-19. So far as I know, these were the first definite suggestions to our Government, but they received quick support, notably from the Biological Survey, then headed by Dr. E. W. Nelson.

This and other support finally led in 1930 to the purchase of 34 head from Norwegian hunters who captured them on the northern east coast of Greenland. They were shipped to Fairbanks, Alaska, where they did well, except that they proved vulnerable to the local bears. For this and other reasons, the herd of 31 was moved in 1935 and 1936 to Nunivak Island in Bering Sea. There they had no enemies. It is said that by the summer of 1943 they numbered 115.

An obvious place for domestication of the musk ox would be the west coast of Greenland, through breeding stock from the east coast. Norwegians, instead of selling their take to Washington, might sell it to Oslo or patriotically contribute to stocking Spitsbergen with these animals, although grazing facilities there are not too good. The Soviets might use them anywhere in Siberia.

Canada has the best chance of all. In no other country is it so easy to capture animals that are wild and deliver them to suitable places of domestication.

THE REINDEER

The domesticated reindeer, though new to large parts of Europe and to European civilization in North America, is of ancient lineage. After the dog, man's first success in mammal domestication may have been the reindeer.

In 1891 the domestic reindeer was introduced into North America, from Siberia across to Alaska, at the suggestion of missionaries. Imports continued until 1902, when they ceased because the government of the czar decided to forbid export. This introduced a breeding stock nucleus usually given at 1,280 head. They multiplied roughly at the rate of doubling every three years.

It looked in 1930 as if nothing could stop the success of the reindeer; but it was stopped through circumstances and conditions which throw a clear light upon some of the main problems of northern development.

The sale of the meat in the United States had been increasing steadily. In New York City, for instance, scores of the best restaurants served it. Prices were somewhat higher than those of beef, although the costs of production, per pound of meat, were in Alaska probably less than one quarter the beef costs in states like Illinois. The price was kept up because the consumer was willing to pay it and because the sellers considered it psychologically the better approach to introduce the product as a rare and costly food, rather than as a cheap one.

Explanations of the new industry's downfall are in their nature controversial. We give essentially our own view, based, however, upon steady contact with the reindeer industry from 1906 on—with many who supported it and with many who fought it.

In the late 1920's the Lomen reindeer interests, of Nome, Alaska, secured New York capital of several millions for bringing to a more rapid head what then seemed to be an inevitably coming industry. As the established steamship line from Alaska refused to expand its cold storage accommodations to furnish refrigeration and other facilities considered necessary, the Lomen interests, as it proved unwisely, set up their own steamship service.

There then ensued bitter competition between the two services. The previously established one had more capital than the Lomens, and it also had a great many ramifications of interest and support. The fight between the transportation companies developed into a fight against and for the reindeer industry.

Serious as this proved to be, another mistake of the Lomens was even more serious. The Department of Agriculture had studied the meat and its findings were highly favorable. Customers liked it. On this basis the company approached three railway lines that run from the Twin Cities to Portland and Seattle, and secured a non-competitive agreement whereby all three would at the same time serve reindeer meat in their dining cars and begin a sales campaign for it. The steward of each dining car would tell any pleased customer the name of a convenient retailer or wholesaler from whom reindeer meat might be procured in almost any given locality.

The campaign was an instant success, which brought nearly instant repercussions. Cattle and sheep men throughout the West began to protest to the railway companies, telling them that since they were serving the northwestern states they should not be disloyal to the industry of those states; they must not use *foreign* meat. (Right up to Pearl Harbor there were considerable numbers in most states of the Union who looked upon Alaska as a foreign country.)

The protest against Alaska reindeer proved to be more violent in the district affected, the northwestern states, than similar protests against Argentine beef or Australian mutton. Against the reindeer they could marshal ignorance, prejudice, and a sense of humor centering about the connection between reindeer and Santa Claus. In some localities vigilante committees threatened dealers in reindeer meat, and in at least one Pacific town the city fathers played upon local prejudice by requiring dealers to classify reindeer meat with rabbit meat, at a time when there were fears of infection from the latter.

Every method was used, from the halls of Congress to the straits of Bering, in a determined fight against a new industry which, it was feared by the northwestern states, would undersell beef and mutton in the long run, since the cost of producing a pound of reindeer meat in Alaska was so much less than the cost of producing a pound of beef in Montana.

The campaign against the use of reindeer meat was so successful that the market, which had been expanding steadily up till then with little promotion effort, now dropped rapidly in spite of extensive promotion. So the New York backers of the industry decided to take their loss, which meant the inevitable bankruptcy of the Lomen reindeer interests.

The Lomen withdrawal meant the ruin of smaller producers, white and Eskimo. Now the market furnished by the Lomen packing houses was gone. The white owners could no longer afford to hire herders to look after their stock; the Eskimo owners no longer felt it worth while to protect their own herds. Efforts to keep the wolf in check were relaxed. Many things began to happen at once—wolf depredations increased; the domestic reindeer herds began to scatter and blend with the herds of their identical twins, the wild caribou; owners began to kill animals for the skins, letting the meat go to waste since it exceeded what was required by the family. Reindeer meat began to be used extensively for dog food, but this gave only a limited, low-price market.

Up to the clash with the cattle and sheep men, and with the Alaska steamship interests, the reindeer herds had been almost, if not quite, doubling every three years, increasing from the initial 1,280 to something between 300,000 and 1,000,000, according to minimum and maximum estimates. Now the herds not merely ceased increasing but started to decrease more rapidly than they had grown, so that there are now (1945) in Alaska probably only about 150,000 head.

For the time being, the project is a failure in Alaska, with only a few minor, local exceptions. Two notable ones are on the large islands of St. Lawrence and Nunivak; there are some smaller islands on which the herds are also doing well. On these islands the ocean does the herding and the wolf is absent.

Before all this happened the Canadian Government decided to follow what was at that time considered the great success of the reindeer in Alaska. They bought an initial herd from the Lomen

interests and in 1935 something over 2,000 head were delivered to the region east of the Mackenzie delta. This herd was looked after carefully by Erling Porsild, a Canadian scientist familiar with the Arctic.

The Canadians are repeating practically every successful step of early Alaskan reindeer history. For the summer of 1943, the reindeer census was given at 12,000 head, most of them in the main herds just east of the Mackenzie delta, with one or two subsidiary herds farther east in the district of the Anderson River, and perhaps by now as far east as the Horton. The great oil developments anticipated in the lower Mackenzie valley will probably provide a home market for the meat whatever the eventual repercussions in southern Canadian markets.

In the Scandinavian countries there is no opposition to the reindeer industry, for it is with them an ancient institution. Moreover, it is recognized that the reindeer Lapps must have some means of support.

Naturally there cannot be the Alaska type of economic reindeer problem in the Soviet Union, for no one anywhere in that country is trying to make money out of beef or mutton. There, as in Canada, it seems likely that northward development of cities will more than take care of the increasing reindeer supply.

The Soviet Government is anxious for an expanded reindeer production. The industry has been included in their five-year plans, and no doubt will so continue. Experimental reindeer institutes have been organized and studies have been made not merely of the welfare of the herds and herders in the North, but also of how an anticipated growing meat production there can best be utilized farther south.

MEAT PRODUCING CAPACITY OF THE ARCTIC

We can form some estimate of the reindeer meat-producing capacity of the Arctic as a whole from estimates made by the United States Department of Agriculture some years ago that

Alaska can support permanently, without over-grazing, about 4,000,000 head. In pounds of meat available per year, this is the equivalent of about 8,000,000 sheep.

The Alaska reindeer pastures are the prairies—the islands of Bering Sea, the Bering coast, and the Arctic coast, together with uplands in the mountain regions, the grasslands that are above the tree line.

The Arctic prairie of Canada is very narrow at the western side, near the Mackenzie delta, for the spruce forest approaches almost to tide water. But as you move east the northern prairie strip, sometimes referred to as "Barren Ground," gets wider and wider until it is several hundreds of miles in width and, on the west shore of Hudson Bay, reaches practically down to Churchill. This prairie also includes all the islands to the north of Canada. These do not have extensive glaciers to interfere except in Heiberg, Ellesmere, Devon, and Baffin, for these are the only ones sufficiently mountainous for the accumulation of permanent snow. In Baffin Island doubtless much less than 5 per cent of the surface is permanently snow-covered, and the surface of Baffin is extensive —more than twice as large as Wales, England, and Scotland together. There is also a certain amount of reindeer grazing land in Labrador and northeastern Quebec, and sections of Newfoundland may prove more profitable in reindeer than domestic cattle.

On the basis of the 4,000,000 estimate for Alaska, we consider that Canada has about ten times as much permanent grazing and therefore accommodation for 40,000,000 head. The Soviet Union probably has more than double the grazing capacity of Alaska and Canada combined, say for 100,000,000 reindeer. How many reindeer there are now in the Soviet Union we do not know, but we do know that the Soviets will almost of necessity bring this meat and leather resource of their country to its maximum.

The reindeer prefers lichens in winter, grasses in summer; the musk ox prefer grasses, sedges and browse through the whole

year. There is, accordingly, much more musk ox feed than reindeer feed in the Arctic, surely fourfold, even when we remember that reindeer prefer grass at times. So there is in the whole Arctic and sub-Arctic room for twice as many musk oxen as reindeer, say 300,000,000, producing as much meat as 600,000,000 reindeer or 1,200,000,000 sheep. However the problem of expansion is much easier with reindeer, since we have on hand, in the Old and New Worlds, tens of thousands of breeding stock. Of musk oxen, there are only a few thousand to start with.

In closing this part of our discussion, it is well to remind ourselves that food is the most important resource of a country. The North can produce a lot of domestic meats if we use native beasts. If we are willing to get our meat, wool, and hides from the musk ox, the reindeer, and perhaps the horse, we can produce on the average, on the Arctic and sub-Arctic prairies, on mainlands and islands which have a greater area than the United States, about as much of these products as can be produced on the same number of acres of those temperate zone and tropic grass lands which are too dry for cereal farming but not too dry for stock ranching.

5. Other Arctic Resources

Important, though we dispose of it in one or two paragraphs, is the wealth of northern waters.

THE SPOIL OF THE SEA

It was announced by Sir John Murray as one of the conclusions of the great *Challenger* expeditions a generation ago that the average quantity of animal life in the ocean, per unit of surface, increases both north and south as you go away from the equator. Although startling when announced in this simplified form, the

principle had really been well known and accepted for a long time, since it is a commonplace that the great fisheries of the northern hemisphere are in the more northerly waters, around Newfoundland, Iceland, and Norway in the Atlantic, on our northern west coast and around Alaska in the Pacific.

The same law is also well known when stated in temperatures, for the great wealth of fish to the east of Newfoundland is in the icy waters of the Labrador Current; when you emerge from these into the Gulf Stream you leave behind also the fishing fleets.

The same principle applies to fresh water. Greatest of our fishing lakes is Superior, which has the coldest water and which gives us not merely quantity but quality. As you proceed north through Canada you find in Slave and Bear Lakes fishing resources that are greater than you would expect for more southerly waters of a like area. And Bear and Slave Lakes are bigger than Lakes Erie and Ontario.

We do not yet know whether the law of increasing fish return for the sea holds all the way to the North Pole, but it is agreed that the margins of the drifting pack are rich in fish life. We do not have, nor do we as yet need, the special technique that would be required for securing fish within the limits of the Arctic pack.

As applied to mammals of the sea, the principle we deal with has long been known.

When Henry Hudson said of Spitsbergen that it would richly repay those who would adventure it, he had in mind the whale, walrus, and seal. The forecast proved accurate, and from his day to the development of kerosene, the margin of the drift ice to the north of Iceland, Scandinavia, and European Russia was the great source of oil for the lamps of the world.

Each of these blubber animals has correspondingly large quantities of red meat which those who are equally used to it like as well as beef or mutton. Therefore our ability to levy upon the northern sea for lean meats as we used to do for fats is largely a question of publicity and methods of introduction.

ARCTIC GARDENS AND FIELDS

As we have mentioned, wheat raising is already successful in Alaska on the fringes of the Arctic, as well as in Canada, and farther north in Siberia. This means the more certain success of other small grains, such as barley and rye. There is no need for hay in the North if we cultivate animals that do not use hay. But if somebody is determined to have stables and to stall feed, then it is significant that among the most northerly plants in the world are standard hay plants, varieties of bluegrass and timothy. You find them near the north coasts of the most northerly islands, farther north than any promontory of either continent.

And where there is the possibility of hay and the small grains, there is a like possibility for garden truck. Tomatoes do not grow without hothouse assistance on the south coast of Alaska, because of the cloudiness produced by the warm ocean; but they do grow several hundred miles farther north, around Fairbanks, where the mountains to the south protect them from the vapors of the Pacific, giving the sun a fair chance. But if the tomato is a bit problematic along the margin of the Arctic, the same does not apply to more important food plants, such as the potato.

NORTHERN MINING

There are successful mining developments in deserts; for instance, those of Chile, and many other regions where food has to be brought in from afar. So it is a convenience rather than a necessity in the development of Arctic mining that food is locally producible. The great coal mines of Spitsbergen were operated profitably in the years just before the war, with food brought from Europe and America, when mines in Wales and in Pennsylvania were closed down or working on a reduced schedule.

In spite of higher wages, there was apparently more money to be made in Spitsbergen coal than in most southern coal lands. This was due to generally favorable conditions. Among them was permanently frozen subsoil.

One of the first and most impressive demonstrations of the economic value of frost was here in Spitsbergen, where the temperatures within the mine shafts are below freezing. This permanent frost has three main advantages. Men work better in a cool mine than in a hot one, thus increasing the tonnage per worker. More important, there was no trouble with water in the mines, and no need to pump. The same low temperature enabled you to get around the problem of timbering up a mine, for you could obtain the same result—in effect shore up walls and ceilings—by spraying into crevices water that immediately turned to ice. You could use a water hose there as you would use an Akeley cement gun in more southerly mines.

It has been suggested that a Pittsburgh can be developed in the Spitsbergen islands on the strength of local coal and iron. One of the greatest known iron deposits in the world is in northern Sweden, around Kiruna and elsewhere well north of the Arctic Circle, and here the developments are both on a colossal scale and along the most modern lines.

The nickel mines of Arctic Finland, purchased in 1944 by the Soviet Government from Canadian interests, are recognized as among the world's greatest. It has been announced, although without much detail, that the Soviets have built up a city at Norilsk, east of the Yenisei 200 miles north of the Arctic Circle, where they produce "minerals necessary to the war effort."

Large radium deposits were developed by the Canadians at Great Bear Lake, just south of the Arctic, with production in such quantity that before the war the price of radium had already dropped to less than half what it had been. The district of the Coppermine, extending roughly 200 miles north from Bear Lake to the middle of Victoria Island and 200 miles east to Bathurst Inlet—thus an area of about 40,000 square miles—is commonly supposed to be one of the world's richest copper regions.

These are mere sample exhibits. A list of the notable Arctic and sub-Arctic mineral discoveries would be too long, even if con-

fined to minerals which are so useful intrinsically that we feel confident they will maintain their value for some time.

Then there are minerals of problematic value, like gold, for which the North is famous—Nome and Fairbanks in Alaska, the Klondike in the Yukon, the Yellowknife region in middle sub-Arctic Canada, the Lena and Kolyma gold fields in Siberia. And gold may retain its value longer than some think; for, to judge by the newspapers, the three great powers of the world are all anxious to keep it at or above its present rating.

OIL IN THE POLAR BASIN

There is so much coal in the world that it is at times a drug on the market. This is not true of oil. According to the current view of the most famous oil geologists, there are likely to be rich fields around any of the mediterranean seas, such as the Gulf of Mexico, the Caribbean, the Old World Mediterranean. Therefore the Polar Mediterranean also has a good chance of proving rich in oil.

These prospects are already developing. The Soviet Government has reported favorable results from oil drilling at various points on the north shore of Asia and in the valleys of the north-flowing Siberian rivers. In North America a pitch lake was discovered more than half a century ago back of Cape Simpson, a little east of Point Barrow, Alaska. The United States Geological Survey reported good prospects of a large oil district in the Cape Simpson and Barrow region, where our Navy had an oil reserve before the present war. The news is just coming out that this region is now being actively developed by our Government.

It is on the basis of specific discoveries as well as of general theory that, for instance, Dr. Wallace Pratt, famous as an oil geologist before he became Vice-President of Standard Oil of New Jersey, has endorsed in print the claim of the Soviet scientists that of all the nations of the world their country is likely to prove richest in oil. It is the same combination of theory and discovery that causes geologists like Dr. Pratt to think the chances

good for rich oil resources in the Mackenzie valley throughout its whole length, from the Athabaska Tar Sands which are at the head of rail, just north of Edmonton, to the mouth of the river in the Arctic Sea, and thence west along the north shore of Alaska.

6. Good Neighbors

A combination of new forces is teaching the least imaginative that global thinking is not an empty phrase, that the shortest route to the Far East is northward from the United States—that the earth is truly round. Chief among these new forces are aviation and the Soviet Union's policy towards its northlands. "North to everywhere" might be aviation's slogan to bring home to Chicago, for instance, that Moscow is a nearer neighbor than Buenos Aires. Canada's nearest neighbor outside North America is, of course, the Soviet Union. A realization of such things gives broad meaning to the Good Neighbor concept.

The longest of single strides toward an understanding of the new neighbors that result from the new world outlook will be taken when we come to know with everyday familiarity the roads that connect us and the realms through which those highways pass.

To this end, flying is the chief means. Flight by the shortest routes to Europe and Asia, great circle flying, will take us through the region that most of us least understand, northern Canada, the Arctic Sea, northern Siberia, the polar lands and seas that were barriers and that are soon to be thoroughfares. We shall come to know the Arctic because the highways take us through it to where we want to go.

After seeing the Arctic we shall want to pause there, for many reasons. It is not a mere thoroughfare but a land with qualities in

its own right. It is a resort country. There are substantial numbers in every nation who like winter sports, especially skiing and snowshoeing. The development of aviation will necessarily build up more and more northerly winter resorts. These will be of secondary importance in that they increase the passenger traffic of the airways and the other transportation agencies. Their primary importance will be that they will tend to speed up man's emancipation from his prejudices in favor of warm climates—prejudices which are natural since our civilization originated from the tropics and since, being conservative, we have dragged northward with us not merely these ideas but also techniques of housing, clothing, and other behavior which, though well suited to the lands where they originated and from which we came, become less and less suitable as we move farther from the equator.

Then there is the direct appeal of Arctic resources. The capitalist countries will want to develop them in the ordinary process of their economic life. The Soviet Government and the increasingly socialistic nations, such as those of Scandinavia, will want to develop northern products for immediate use by their peoples.

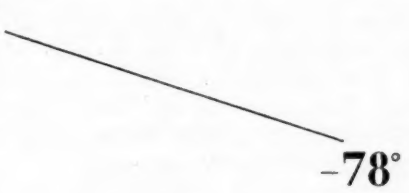
We mention last a factor which all of us hope will not become applicable, but the applicability of which many fear. It is that, if the great powers do not have complete faith in the efficacy of the world organization which they set up when the war is over, then those three of them that are closest to the Arctic, the British Commonwealth of Nations, the United States of America and the Union of Soviet Socialist Republics, will necessarily take precautionary steps with regard to a possible third world war.

A third world war would be the first truly global war, since it would be the first in which air transportation, as well as air fighting, takes a leading role. This would mean in essence that the British through Newfoundland and Canada, the United States through Alaska, and the Soviet Union through the territories that stretch from Scandinavia to Bering Strait, would prepare some sort of fortifications to the north, some method of defense of each

against the others. For just as truly as "North to Everywhere" is going to be the slogan of commercial aviation, so "War may come from the North" will express our fear of a future conflict.

The knowledge that war from the north is possible will of necessity lead to a study of northern conditions and the development of northern resources. The fear of war from a hitherto unconsidered military frontier should make us the more determined to erect a world organization which will see to it that war shall not come from any direction.

Fort Yukon: a case history in extremes of heat and cold



EVELYN STEFANSSON

ONE PLACE IN ALASKA, AND ONLY ONE, HAS A WEATHER BUREAU record of 100° in the shade. It is Fort Yukon in the Arctic part of the Territory, a few miles north of the Circle. Fort Yukon also holds the Bureau's record as the coldest place in Alaska—78° below zero according to official figures up to 1941, and 80° below according to 1943 newspaper reports.

Fairbanks, a hundred miles within the temperate zone, has a heat record of 99°. No Alaska town farther south has ever seen a day warmer than 96°. Localities farther north than Fort Yukon, deeper within the Arctic in the valleys of the Kobuk and Noatak, have claimed an unofficial 100°.

Alaska's hottest and coldest spot is remarkable for a number of other things as well. The Fort, established by the Hudson's Bay Company in the great days of the fur trade, marks the farthest westward penetration of British power in North America, and the eastward limit of Russia's power. It is the most northerly place reached by the Yukon River steamers, which bring tourists to see

the midnight sun. For many years its hospital was the Territory's most northerly one, but that distinction has now passed to the hospital at Barrow.

We shall confine our discussion in this article to Fort Yukon's extremes of temperature. Alexander Hunter Murray, who selected the site as a trading post, wrote of his first summer there:

> "We were fortunate in having generally fine weather but there were often gales of wind, thunder storms and rain. The month of July was oppressively warm, the thermometer ranging so high that it would not have disgraced the tropics. I never before spent a summer so far north and could scarcely have credited others had I been told."

It is a hundred years since Murray was surprised by the heat of Fort Yukon; summer visitors are still astonished.

The naturalist William H. Dall who represented the Smithsonian Institution through a distinguished career had been in Alaska from 1865 to 1868, before he joined them. He wrote:

> "At Fort Yukon I have seen the thermometer at noon, not in the direct rays of the sun, standing at 112°, and I was informed, by the commander of the post, that several spirit thermometers, graduated up to 120.0°, had burst under the scorching sun of the Arctic midsummer; which can only be thoroughly appreciated by one who has endured it."

The Weather Bureau, in half a century of meticulous recording, has never gone above 100° in the shade, and there must have been something wrong with a thermometer that recorded 112° in Dall's time. But we know from plentiful testimony that it feels that hot. Certain facts of Arctic nature and of human nature make it seem hotter at Fort Yukon than the thermometer will confirm.

The first reason is psychological. We are brought up with the idea that heat is extreme in the tropics, moderate in the temperate zone, non-existent in the frigid zone. There are still

in use school books which teach that it is always cold north of the Arctic Circle. People therefore come to the Arctic mentally and physically unprepared for the heat of midsummer. Their clothes have been chosen on the theory that places as far north as the Yukon River must be cool. Tourists sweltering in their heavy woolens are inclined to be resentful. For the ordinary tourist agency seems not too anxious to explain in advance about the northern swelter; it is part of their stock in trade to urge you to flee the known heat of places like the Mississippi valley for the supposed July coolness of the Yukon.

A second and very important reason for exaggerated reports, such as Dall's 112° temperature, is that you cannot "dress cool" in the Arctic because of the mosquitoes. Nobody has described the mosquitoes better than Murray did in his journal. We quote from his June 25 entry, when he was two or three miles short of what he later chose as the site of the Fort.

> ". . . we put ashore at the entrance to a small lake at ½ past 9 o'clock for the purpose of encamping, but the mosquitoes seemed determined we should not . . . I have been in the swamps of Lake Ponchartrain and the Belize, along the Red River (Texas) and most parts of the 'Gullinipper' country, but never experienced anything like this; we could neither speak nor breathe without our mouths being filled with them; close your eyes, and you had fast half a dozen. Fires were lit all around, but of no avail."

With mosquitoes as bad as that, you must wear over your whole body clothes so thick that the pests cannot bite through them; this means gloves, leggings and a face net closely enough woven to shut out the smallest insects, therefore so fine that it interferes with air circulation around your face and you feel stifled. Imagine wearing that sort of gear in the streets of New York on those rare occasions when the heat of Manhattan is quoted by the Weather Bureau at 100° in the shade, or even at 95° or 90°!

In addition to mosquitoes there are sandflies, and horseflies that are locally called bulldogs, perhaps because their bite sets a small stream of blood flowing where, apparently, they have taken a piece out of your skin. But the winged pests do not trouble you much as long as you are in the village, where people have trampled down the grass and where the gardens are well drained.

For about fifty days of each year Fort Yukon has a temperature of 70° or higher. As the summer months approach, the days gradually lengthen until in late June the sun no longer sets. The whole growing season, according to the Department of Agriculture, is eighty-one days. But counting days is not the whole story.

The sun shines only about twelve hours a day on the wheat fields at the tropical head of the Amazon River in South America; it shines twenty-two hours a day on the extensive fields of the sub-Arctic Tanana valley near Fairbanks, Alaska, where the growing of wheat has been successful now for a generation; it shines twenty-four hours a day in the middle of the season on the gardens at Arctic Fort Yukon.

It may not be strictly accurate but it is close to the truth to say that one day in the Arctic is worth two days in the tropics—plants such as wheat work a single 12-hour shift per day on the Amazon but two 12-hour shifts per day on the Yukon. This explains the ripening of potatoes in the Yukon valley about the same date as in Maine or Michigan.

When the potatoes are maturing in the garden of the Hudson Stuck Memorial Hospital you may have a vertical range from blood heat to frost in less than six feet. Four feet above the ground, at the prescribed minimum elevation of Weather Bureau instruments, the temperature may be 98° in the shade, the warmth of your blood. It would then be even hotter than that on the surface where the light of the sun strikes the black earth and is converted into heat. Down around the potato roots, where

the tubers are growing, the warmth seems to be just about right for them. The moisture is also right; for when the heat penetrates a little farther down it converts the permanently frozen soil into mud from which the plants can suck up the moisture they need. Go a foot or so beneath the tubers and you reach permanently frozen ground; bore a hole just one inch down into the frost and your thermometer will register below the freezing point.

If you keep on boring down, the chill of the frozen earth will increase steadily. We do not know what the coldest temperature is downward; but a "twenty-degree frost" (12°F.) has been reported from certain Arctic mining operations. Neither do we know how thick the frozen layer is here, just north of the Yukon River, but depths of 300 feet and more are known from other places.

Back of the Fort the trees of the spruce forest are slender, straight and tall, some running to sixty, seventy and eighty feet in height. In their dense shade the ground thaws so little that at the end of a summer which is long and warm enough for the ripening of wheat, you can stab a hunting knife—or a table knife for that matter—down into the permanent frost with a single stroke.

That the frost is there is an advantage to your crop, whether it is wheat, clover hay or potatoes. This is one of the innumerable contradictions which the North presents to our usual beliefs—and of which Fort Yukon supplies more than its share.

ABOUT THE AUTHORS

VILHJALMUR STEFANSSON's provocative ideas about the future of the Arctic and sub-Arctic are based on many years of study. During 1905 he conducted an archeological expedition to Iceland for Harvard University. In 1906-07 he spent eighteen months with an ethnological expedition to the Mackenzie Delta sponsored by Harvard and Toronto Universities. From 1908 to 1912 he explored northern Alaska and northwestern Arctic Canada, fifty-three continuous months, under the auspices of the American Museum of Natural History and the Canadian government. In 1913-18 he spent sixty-five months as Commander of the Canadian Arctic expedition, to and beyond the Canadian and Alaskan Arctic. He has received the thanks of the Canadian government for his explorations and writings, holds honorary degrees from several universities and medals from numerous learned societies. Among his books are *Hunters of the Great North*, *My Life with the Eskimo*, *The Friendly Arctic*, *The Northward Course of Empire*, *Iceland*, *Ultima Thule*, *Greenland*, *Arctic Manual*. He is co-editor with Hans W. Weigert of *Compass of the World*. Since 1932, he has been advisor on northern operations to Pan-American Airways and has had since 1935 a similar relation to the United States Army; since 1941 he has been engaged in certain Arctic work for the United States Navy.

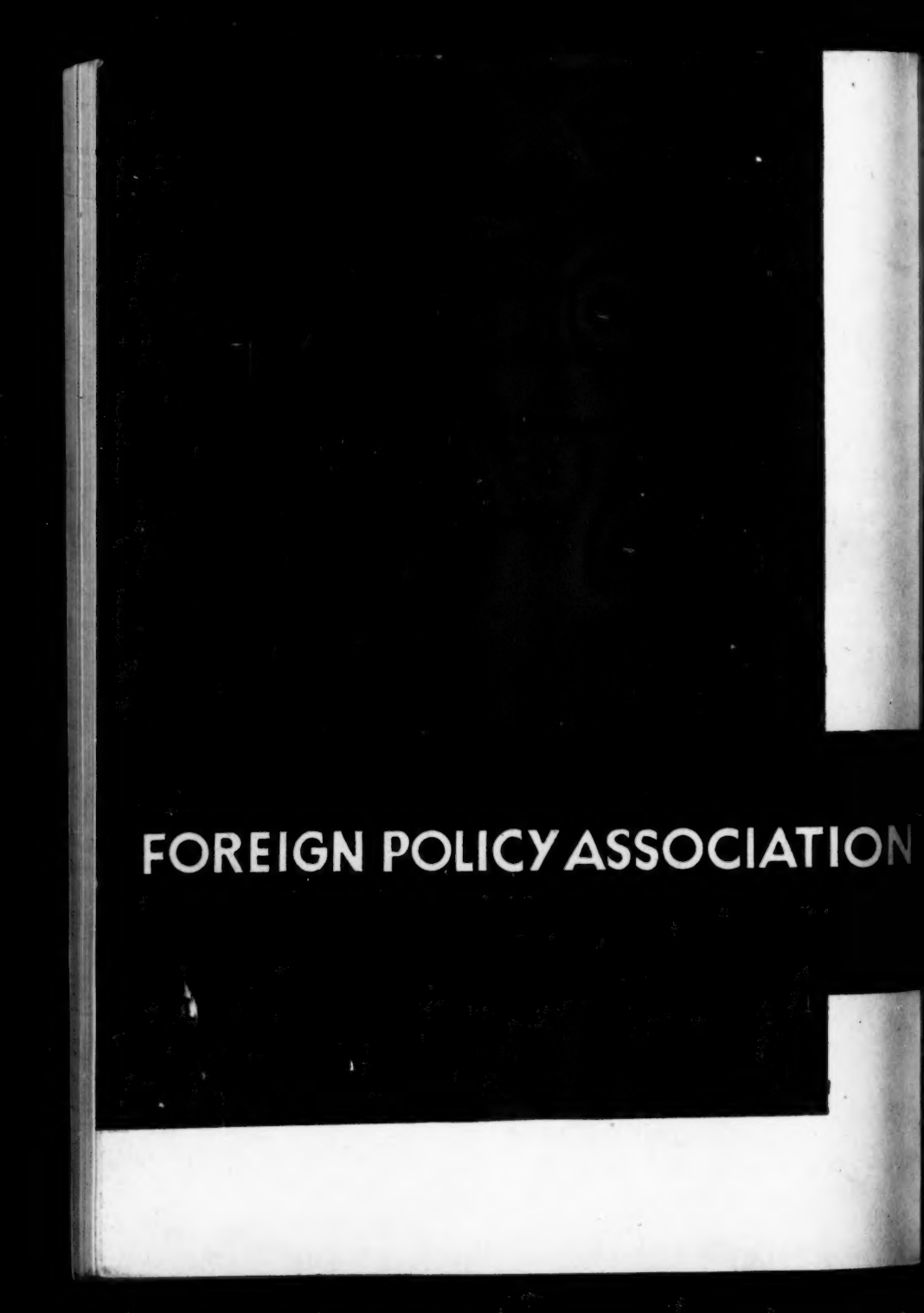
EVELYN BAIRD STEFANSSON is librarian of the 20,000 volume Stefansson Library of polar books and manuscripts. She is author of the books *Here is Alaska* and *Within the Circle: Portrait of the Arctic*.

A NOTE ON HEADLINE SERIES

The object of the Foreign Policy Association's HEADLINE SERIES is to provide sufficient unbiased background information to enable readers to reach intelligent and independent conclusions on the important international problems of the day. HEADLINE SERIES articles are prepared under the supervision of the Department of Popular Education of the Foreign Policy Association with the cooperation of the Association's Research Staff of experts.

The Foreign Policy Association is a non-profit American organization founded "to carry on research and educational activities to aid in the understanding and constructive development of American foreign policy." It is an impartial research organization and does not seek to promote any one point of view toward international affairs. Such views as may be expressed or implied in any of its publications are those of the author and not of the Association.

For further information about HEADLINE SERIES and other Foreign Policy Association publications, write the Department of Popular Education, Foreign Policy Association, 22 East 38th Street, New York 16, N. Y.


FOREIGN POLICY ASSOCIATION

ON